REPORT

WORK PLAN FOR UPPER BASALT ZONE (UBZ-2) SOURCE AREA CHARACTERIZATION

Monsanto Soda Springs Idaho Plant

Submitted To: Monsanto Company
Soda Springs Plant
Highway 34
Soda Springs, ID 83276

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August 3, 2011 **913-1101-002.002.2G**

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1.0 INTRODUCTION

This Work Plan presents the purpose, scope and methods for the characterization of the potential source areas in UBZ-2 at the Monsanto Soda, Springs Idaho Plant (Plant) site. The Old Underflow Solids (UFS) Ponds, coke and quartzite dust settling pond, sewage evaporation ponds, slag, and former non-contact cooling water ponds and ditches are potential source areas for groundwater plumes in UBZ-2 (Golder 1995). The additional source area characterization was requested by the U.S. Environmental Protection Agency (USEPA) and the Idaho Department of Environmental Quality (IDEQ) following review of groundwater conditions and natural attenuation of the constituents of concern at the Plant site (CH2M Hill 2010). The characterization of the Old UFS Ponds and other potentials sources will provide information on the nature and extent of any remaining underflow solids or other materials, the geochemistry of the aquifer materials, and the geochemistry of any remaining underflow solids or other potential sources materials to evaluate the current source area concentrations of the constituents of concern and controls on natural attenuation.

This Work Plan is organized into the following sections:

- **Section 2** presents a brief background section that includes a brief description of the UBZ-2 source areas and existing groundwater and groundwater quality conditions at the site
- **Section 3** present the approach to the field investigations
- **Section 4** describes the field investigations
- **Section 5** presents a schedule to complete the work
- **Section 6** is the signature page
- **Section 7** includes references

All work will be performed in accordance with State of Idaho monitoring well construction regulations (IDAPA 37.03.09, IAC 2010) included in Appendix A and the technical procedures and quality assurance/quality control procedures are presented in Appendices B and C.

2.0 BACKGROUND

The Monsanto Soda Springs Plant (Plant) is located one mile north of the City of Soda Springs, Caribou County, Idaho (Figure 1). The site covers an area of approximately 800 acres, with the fenced plant site accounting for 540 acres.

Monsanto purchased agricultural land in 1952 to construct the Soda Springs elemental phosphorus production plant. The Plant uses locally mined phosphate ore. In 1984, Golder Associates Inc. (Golder) was retained to assess the impact of operations on groundwater and surface water quality at the Plant. The 1984 study found elevated concentrations of cadmium, selenium, fluoride and sulfate in groundwater beneath the Plant (Golder 1985). The sources of these constituents were determined to be the Old UFS Ponds, the Northwest Pond, and the Old Hydroclarifier. The investigation also concluded that groundwater under the southeastern portion of the plant contained elevated concentrations of vanadium, chloride, and sulfate. Based on groundwater flow directions and geochemical data, the elevated concentrations of these constituents in the southeastern portion of the Plant were attributed to the Kerr-McGee Chemical Corporation (now Tronox) facility located to the east of the Plant, across Highway 34 from the Plant, and was further supported by findings from a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site inspection conducted in 1988 and supported by the results of the Remedial Investigation/Feasibility Study (RI/FS) activities completed at the Plant (Golder 1992, 1995).

Monsanto conducted and submitted to the USEPA a Phase I RI in 1992 (Golder 1992) and a Phase II RI in 1995 (Golder 1995). A Record of Decision (ROD) was signed by Monsanto and the USEPA in 1997. The selected remedy for groundwater is monitored natural attenuation. Bi-annual groundwater monitoring was in place from 1991 to 1998, and annual groundwater monitoring has occurred since 1998. Annual groundwater, surface water, and non-contact cooling water discharge monitoring is conducted at and near the Plant in order to ensure that natural attenuation is proceeding per modeled predictions (Golder 2003, 2008), and to monitor the natural attenuation process. Annual groundwater and surface water quality reports are prepared following completion of the annual sampling to evaluate groundwater quality and short-term groundwater quality trends. Long-term groundwater and surface water quality trends are statistically evaluated as part of the Five-Year Review process (Golder 2003, 2008).

An evaluation of natural attenuation in the UBZ-2 was completed in 2010 (Golder 2011). The evaluation of natural attenuation indicated that concentrations of cadmium, fluoride, and manganese are controlled by the precipitation of mineral phases (otavite, fluorite, and rhodochrosite, respectively). Cadmium concentrations are also affected by the presence of chloride. As chloride concentrations increase, the formation of cadmium-chloride complexes occurs and cadmium is remobilized. Increasing chloride concentrations as a result of runoff and infiltration of dust suppression chemicals (specifically magnesium chloride) has been observed in UBZ-2 at monitoring well TW-37 (Golder 2011).

Concentrations of nitrate and selenium in UBZ-2 are not controlled by mineral precipitation. These constituents are transported conservatively and concentrations of these constituents are affected by limited dispersion only.

2.1 Potential UBZ-2 Source Areas

The potential UBZ-2 source areas are shown on Figure 2. The Old Underflow Solids Ponds are the primary source areas in UBZ-2. There are also other recognized potential source areas such as the slag pile, old coke and quartzite slurry pond, and former non-contact cooling water pond and ditch. There may also be a potential source area between wells TW-37 and TW-22/24 based on differences in changes in water quality between those two locations during periods of above average precipitation (Golder 2008). This includes observations of increases in fluoride, manganese, and molybdenum in wells TW-22 and TW-24 that were not observed in TW-37.

2.1.1 Old Underflow Solids Pond

The Old UFS Ponds were located on the west side of the Monsanto Plant Site (Figure 2). The Old UFS Ponds were used to dewater underflow solids from the Hydroclarifier. Dewatering occurred by directing a slurry into the ponds and allowing infiltration of the fluid portion. The remaining solids had phosphate ore value and were excavated from the pond and further processed.

The Old UFS Ponds were taken out of service in 1983. In 1987, the Old UFS Ponds were closed by excavating the materials in the ponds and filling the ponds with molten slag. The slag was characterized as part of the RI activities and passed TCLP testing (Golder 1995). A one-foot thick bentonite cap was then placed over the ponds, and a crushed slag cap was placed over the bentonite cap (Golder 1995, page 1-11 and Appendix L). The bentonite and slag caps were oversized to provide an infiltration barrier to the closed ponds and surrounding soils. An estimated 35,000 tons of material were left in the pond following closure (Golder 1995, Appendix L).

Underflow solids from the underflow solids piles were characterized as part of the RI activities (Golder 1995). The characterization indicated that the underflow solids contained elevated concentrations of selected constituents including cadmium, fluoride, and selenium.

Recent evaluations of the Old UFS Ponds indicated chloride and cadmium concentrations were increasing in monitoring well TW-37 downgradient of the Old UFS Ponds. Chloride concentrations may be increasing because of dust control (magnesium chloride) activities at the Plant. Increasing chloride concentrations may result in mobilization of cadmium as cadmium chloride complexes, resulting in increased cadmium concentrations (Golder 2011).

2.1.2 Calcium Silicate Slag

Calcium silicate slag is a by-product of the furnace operations. The slag is poured in molten material at a large stockpile which covers the southern portion of UBZ-2 (Figure 2). The slag passes TCLP toxicity test (Golder 1995).

2.1.3 Former Coke and Quartzite Slurry Pond

The former coke and quartzite pond was located in the southwest corner of the Plant. The coke and quartzite slurry pond was located in UBZ-2 (Figure 2). Coke and quartzite dust were originally collected using a wet scrubber system. The dust slurry collected buy the scrubber system was directed to the pond for dewatering. The pond was taken out of service in 1987 when a new coke and quartzite dryer was installed. The pond is now filled with calcium silicate slag. The coke and quartzite slurry pond was not identified as a source of groundwater contamination in the Phase II RI (Golder 1995).

2.1.4 Former Non-Contact Cooling Water Ponds and Ditch

Non-contact cooling water used to cool the furnace shell and other process equipment is obtained from Plant production well PW-3 and supplemented with water from production wells PW-01 and/or PW-02 as needed. After cooling the furnaces, the water is passed to a pond for settling and cooling. Sometime in the 1990's, the cooling water pond was located in the southeast corner of the Plant, primarily in UBZ-1 with a small portion of the pond in UBZ-2. A ditch and subsurface pipeline was used to convey water from the ponds to Soda Creek for discharge. These ponds are now covered with slag.

Non-contact cooling water is currently piped to a lined cooling pond located to the southwest of the Plant, south of Hopper Springs Road (Figure 2).

2.1.5 Former Sewage Evaporation Ponds

Two sewage evaporation ponds were located in the southeast corner of the Plant, primarily in UBZ-1 with a small portion of the ponds in UBZ-2. The ponds were used to treat sanitary wastewater from the Plant. Wastewater from the ponds infiltrated to the subsurface, evaporated, or applied to nearby fields. The sewage evaporation ponds were used until the fall of 1993 when the Plant was connected to the City of Soda Springs wastewater treatment facility. The area of the ponds is covered in slag.

2.1.6 Other Potential Sources

Evaluation of groundwater quality data from wells TW-22, TW-24, and TW-37 as part of the 2008 Five-Year Review (Golder 2008) suggested a source may be present between the Old UFS Ponds and the coke and quartzite slurry pond, near wells TW-22 and TW-24. This source appears to intermittently release sulfate, chloride, nitrate, fluoride, selenium, cadmium, manganese, and molybdenum.

There are also industrial materials stockpiled on the location of the Old UFS Ponds that could be potential sources in UBZ-2. These materials include:

- Silica (coarser grained sand used in building slag runners in the furnace)
- Cinders (used for traction in winter, may be mixed with salt)
- Pit run slag
- Crushed slag (used for railroad ballast)

2.2 Hydrogeology

The hydrogeology at the Monsanto Plant is presented in detail in Golder (1995), and updated in Golder (2010). The primary hydrostratigraphic zones underlying the Monsanto Plant include the Upper Basalt Zone (UBZ) and the Lower Basalt Zone (LBZ). The principal aquifer is the UBZ which extends to a depth of about 100 feet below ground surface (bgs) below the Plant and the area surrounding the Plant. The UBZ consists of up to three permeable interflow zones designated γ3, γ4, and γ5 that consist of cinders, broken and rubbly basalt, and sedimentary materials. The interflow zones are separated by lower-permeability basalt flows. Groundwater elevation data and pumping tests demonstrate a vertical hydraulic connection between the UBZ interflow zones (Golder 1995).

The depth to the water table ranges from 20 feet bgs in the northeast corner to 100 feet bgs in the center of the Plant. The Old UFS Ponds are in UBZ-2. In the vicinity of the Old UFS Ponds, groundwater is about 70 to 100 feet below ground. Groundwater flow in the UBZ and LBZ is a function of faulting, regional hydrogeologic conditions, and pumping of the plant production wells. The UBZ and LBZ are broken into smaller regions (UBZ-1 through UBZ-4 and LBZ-1 through LBZ-4), based on faulting, hydrogeological controls, and groundwater quality. The Old UFS Ponds are in UBZ-2. Details pertaining to the breakdown of UBZ and LBZ regions are provided in Golder (1992) and Golder (1995).

CH2M-Hill (2010) reviewed the 2009 groundwater conditions report (Golder 2009a) and identified several uncertainties in the conceptual hydrogeologic model of the site in UBZ-2, including the hydraulic nature of the Subsidiary Fault separating UBZ-1 and UBZ-2 west of the Plant, and areal distribution of the constituents of concern, particularly selenium, south and west of the Plant fenceline in UBZ-1 and UBZ-2, and conditions in the Old UFS Ponds area. The UBZ-2 source area characterization proposed for 2011 are designed to provide data on source area concentrations of the constituents of concern to address uncertainties in source area conditions, groundwater quality, and natural attenuation in UBZ-2.

3.0 APPROACH

The USEPA requested that Monsanto characterize the source areas in UBZ-2 (Old UFS Ponds) in order to:

- Evaluate geochemical conditions in the vadose zone and UBZ-2 aquifer in the Old UFS Ponds area
- Evaluate the presence of residual underflow solids in the Old UFS Ponds area

To meet these goals, the following approach is proposed:

- Phase 1 – Review of Existing Information
  - Review of available information for the potential source areas in UBZ-2, including operation and closure information, and existing sampling and characterization data.
- Phase 2 – Field Investigations and Analysis
  - Drill several boreholes in order to collect samples of the subsurface materials
  - Perform geochemical analyses for metals and fluoride on selected samples to evaluate bulk geochemistry
  - Perform x-ray diffraction analysis on selected samples to evaluate mineralogy
  - Perform leach (SPLP) tests on selected samples
- Phase 3 - Interpret and report the results of the investigations

4.0 PHASE 1 - HISTORICAL REVIEW

Existing information on the potential UBZ-2 source areas will be reviewed and summarized including:

- Operations and closure history of the Underflow Solids Ponds based on information in Monsanto files
- Materials characterizations (Underflow Solids and other materials in use or stockpiled historically in the UBZ-2) conducted as part of the Phase I and II RI/FS work
- Groundwater quality in the area of TW-37, TW-22/24, TW-36, and TW-7/8/9 and 10
- Mapping and aerial photographs of the UBZ-2 area to evaluate changes in the land surface and stockpiled materials or ponds since 1985
- Inventory of materials currently stockpiled in the area of the UBZ-2

5.0 PHASE 2 - FIELD INVESTIGATIONS

Boreholes will be drilled in the area of the Old Underflow Solids Ponds and other UBZ-2 source areas to collect samples of the geologic materials in the vadose zone and below the water table and any remnant underflow solids. The number and location of boreholes will be proposed following Phase 1. The boreholes will be decommissioned following completion of drilling.

5.1 Borehole Drilling and Sampling

Boreholes will be drilled at locations determined from the data review and access. The boreholes will be advanced to a depth of about 100 to 120 feet below ground, or about 10 to 20 feet below the water table (Table 1). The final borehole locations will be determined following review of the site conditions and access for the drilling equipment.

Monsanto will select a qualified drilling contractor to drill and decommission the boreholes. The boreholes will be drilled and decommissioned in accordance with the Idaho Administrative Procedures Act for Well Construction Standards Rules (IDAPA 37.03.09; IAC 2010), and in accordance with Golder Technical Procedure TP-1.2-5 for Drilling, Sampling, and Logging of Soils (Golder 1996a). Copies of the Idaho well construction regulations are included in Appendix A, and technical procedures for borehole drilling and sampling are included in Appendix B for reference. Permits ("start cards") will be obtained from the Idaho Department of Water Resources (IDWR) prior to borehole drilling. The contractor will file well logs and any other required information with IDWR at the completion of drilling.

The boreholes will be drilled using an air-rotary drilling rig. Temporary casing will be used, if needed, to control borehole stability problems though slag, fill materials, interflow zones, or unconsolidated surficial materials. The borehole diameter will be a minimum of 8 inches. Formation samples (cuttings) will be collected every five feet or at formation changes and geologically logged during drilling. The following will be noted:

- Lithology of materials intersected
- Structure (fractured, dense, etc.)
- Depth(s) of groundwater-bearing zones intersected
- Water content (dry, damp, moist, wet)
- Air-lift flow rate in groundwater-bearing zones (if possible)
- Drilling action and zones of lost circulation, fracturing, changes in penetration rate, etc.
- Groundwater level at time of drilling, if possible to measure

Field groundwater quality parameters (temperature, pH and conductivity) will be periodically measured in any groundwater airlifted from groundwater-bearing zones.

5.1.1 Drilling Water and Decontamination

Monsanto will designate a source of water (PW-04) to be used for drilling and borehole decommissioning. PW-04 is located at the north end of the Plant and is not affected by Plant activities. Water may be introduced during drilling if needed to control dust or assist in cuttings return. No other additives will be used during drilling.

All down-hole equipment (temporary drive casing, drill bits, samplers, drill rods, airlift tools, bailers, and water level indicators) shall be thoroughly cleaned upon arrival at the site and between boreholes with a high-pressure, high temperature, jetted stream of potable water and an approved detergent (Alconox) followed by a clean rinse. Decontamination will be conducted at a decontamination area designated by Monsanto within the Plant site. Only approved drilling lubricants specifically designed for monitoring wells (vegetable oil-based or Teflon grease) will be used for all downhole equipment to prevent the introduction of petroleum hydrocarbons.

5.1.2 Borehole Decommissioning

At the completion of drilling, the boreholes will be decommissioned by pressure grouting the borehole from the bottom up using high-solids bentonite grout. Any temporary casing will be removed and a concrete cap will be placed over the borehole. The borehole location will be staked for surveying.

5.2 Materials Sampling and Analysis

Samples for chemical analysis will be collected from the boreholes at 5-foot intervals during drilling. Samples will be collected and stored in accordance with Golder Technical Procedure TP-1.2-18 Sampling Surface Soil for Chemical Analysis (Golder 1996b; Appendix A).

Samples intervals will be selected for analyses based on depth and location above or below the water table, material type, and presence of residual underflow solids materials. The analyses will include:

- Geochemistry (metals and fluoride; Table 1)
- X-ray diffraction (with Reitveld refinement)
- SPLP leach testing

All samples will be stored and transported on ice under Chain-of-Custody according to Golder Technical Guideline TG-1.2-23 *Chain of Custody* (Golder 2009b).

6.0 PHASE 3 – EVALUATION AND REPORT

A report will be prepared describing the UBZ-2 source area characterization. The report will include the following information:

- Description of potential sources from information review
  - Hydrogeologic setting
  - Materials characterization
  - Source area history and closure
  - Groundwater quality
  - Aquifer properties including hydraulic conductivity
  - Groundwater flow directions
- Results of field investigations
  - Borehole logs with descriptions of materials intersected
  - Results of geochemical characterizations and XRD analysis
- Interpretation of Results
  - Identification of groundwater sources in UBZ-2
  - Source area constituent concentration history
  - Source area geochemistry and mineralogy
  - Conceptual hydrogeologic and geochemical model for UBZ-2

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

7.1 Laboratory Analyses

The primary laboratory used for the geochemical and SPLP analyses is SVL Analytical. The laboratory used for analysis of split samples is Analytical Resources Inc. Other laboratories may be used for specialized analytical services at the discretion of Monsanto or the Golder project manager.

Contact information for the primary laboratory is:

SVL Analytical
One Government Gulch
PO Box 929
Kellogg, ID 83837-0929
ATTENTION: Chris Meyer
(800) 597-7144 or (208) 784-1258
(208) 783-0891 (fax)

The primary split laboratory is:

Analytical Resources Inc.
4611 South 134th Place
Tukwila, WA 98168
ATTENTION: Mark Harris
(206) 695-6200
(206) 695-6201 (Fax)

Monsanto is evaluating a second split laboratory:

IAS Envirochem
3314 Pole Line Road
Pocatello, Idaho 83201
ATTENTION: Ryan Pattie
(208) 237-3300

The laboratory for XRD analysis is:

SGS Minerals Services, Vancouver
Kent Corporate Centre
#50-655 West Kent Avenue N.
Vancouver, British Columbia, V6P 6T7
(604)324-1166
(604) 324-1177 (fax)

All analytical samples shall be subject to quality control (QC) measures in both the field and laboratory as detailed in the project QAPP (Appendix C). The following minimum field quality control requirements apply to all analyses. These requirements are adapted from Test Methods for Evaluating Solid Waste (SW-846), USEPA (2007).

- ***Field duplicate samples***. An effort will be made to obtain sufficient sample quantities for the purpose of collecting field duplicates. Field duplicates will be collected from cuttings samples that are suspected, based upon field observations, to contain contaminants, and where volume requirements are sufficient. Duplicate samples shall be collected from the same sampling interval using the same equipment and sampling technique, and shall be placed into identically prepared and preserved containers. At a minimum, duplicate samples will be generated for cuttings samples at a frequency of one duplicate per 20 samples. All field duplicates shall be identified with a unique sample ID number and will be analyzed independently (blind) as an indication of gross errors in sampling techniques.
- ***Split Laboratory samples***. Split samples are identical samples collected from the same interval at the same time in the same way, contained and transported in the same manner, but are sent to an alternate laboratory. Split samples are used as a performance audit of the primary laboratory. At a minimum, split samples will be generated for cuttings samples frequency of one duplicate per 20 samples. Split sampling shall be distributed evenly throughout each sampling period, with representative samples suspected to contain contaminants and where volume requirements are sufficient.

7.2 Sample Designation

All samples will be designated with a unique sample identification number in accordance with technical procedure TP-1.2-18 *Technical Procedure for Sampling Surface Soil for Chemical Analysis*.

At a minimum, the sample label shall include the following:

- Sample designation
- Sample date and time
- Sampler's name
- Sample analyte(s)
- Chemical preservative, if required

7.3 Chain of Custody

All samples obtained during the course of this investigation shall be assigned a unique sample number and controlled under Chain of Custody at all times in accordance with technical guideline TG-1.2-23 *Technical Guideline for Chain of Custody* (Golder 2009b). Chain of Custody forms (see Exhibit C in TG-1.2-23) shall be completed for each shipment of samples as described in the procedure. Sample Integrity Data Sheets shall be completed for all sample collection locations, and cross reference the location and sample depth with the sample identification entered on the Chain of Custody. All laboratory chain of custody and sample tracking procedures shall ensure traceability of analytical results to the original samples through the analytical method referenced on the chain of custody, and the laboratory applied tracking number, which is traceable to unique sample identification numbers.

Custody seals will be placed on the refrigerator in the lab basement used to store samples until they are shipped to the analytical laboratories.

7.4 Data Validation and Management

Analytical data collected during the annual groundwater sampling will be validated in accordance with the USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review (USEPA 2010) and the Monsanto QAPP (Appendix C),

Validated laboratory data will be uploaded to a database. All hard copy laboratory data and field notes will be archived.

8.0 SCHEDULE

Construction and sampling of the boreholes will be scheduled to be completed following USEPA approval of the Work Plan. The major components of the schedule include the following:

- Draft Work Plan (August 2011)
- Final Work Plan (September 2011)
- Review of Existing Information (September/October 2011)
- Finalize borehole locations (TBD)
- Complete boreholes (TBD)
- Laboratory analysis and data evaluation (TBD)
- Reporting of results of borehole drilling and laboratory analysis (TBD)

Table 1: Analytical Constituents, Preservatives, Holding Times, and Analytical Methods

Analytical Group	Analytical Constituent	Preservative	Holding Time	Analytical Method
Metals	Ag, Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Mg, Mn, Ni, Pb, K, Na, Sb, Se, Tl, V, Zn, Hg	Cool, 4°C	180 days	200.7/6010
Fluoride	F	Cool, 4°C	28 days	300.0
XRD	Mineralogy	None	None	X-Ray Diffraction
SPLP	Ag, As, Ba, Cd, Cr, MnPb, Se, Hg	Cool, 4°C	None	1312/6010

9.0 CLOSING

For questions regarding this Work Plan, please contact the undersigned.

GOLDER ASSOCIATES INC.

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DRAFT

David Banton
Principal Hydrogeologist

MK/DB/tp

10.0 REFERENCES

CH2M Hill. 2010, Draft Comments on 2009 Summary Report on Groundwater Conditions at the Monsanto Soda Springs Plant, June.

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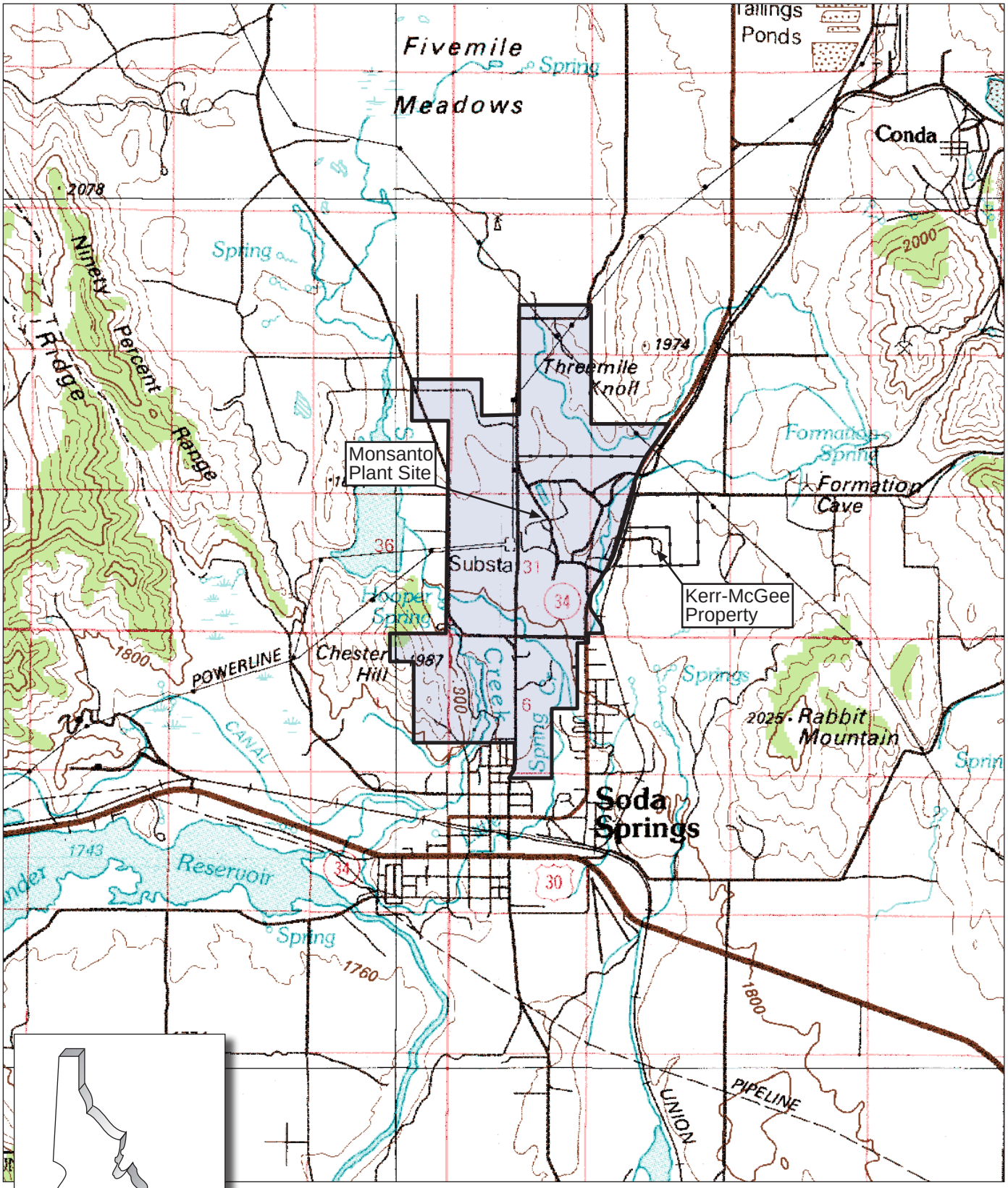
FIGURES



Source: Topographic map of the USGS Soda Springs Quadrangle (1:100,000) 1982.

FIGURE **1**

MONSANTO PLANT VICINITY MAP

MONSANTO/UBZ-2 SOURCE AREA WORK PLAN/ID

LEGEND:

- MONSANTO PROPERTY BOUNDARY (APPROXIMATE)
- PLANT PERIMETER FENCE
- CREEK / IRRIGATION DITCH
- FACILITY AREA
- ORIGINAL SOURCE AREA

- TW-60 MONITORING WELL LOCATION WITH NAME IN GROUNDWATER ZONE UBZ-1
- LEWIS MONITORING WELL LOCATION WITH NAME IN GROUNDWATER ZONE UBZ-2
- TW-56 MONITORING WELL LOCATION WITH NAME IN GROUNDWATER ZONE UBZ-3
- TW-33 MONITORING WELL LOCATION WITH NAME IN GROUNDWATER ZONE UBZ-4
- PW-1 PRODUCTION WELL LOCATION WITH NAME IN GROUNDWATER ZONE UBZ-4
- ✳ POINT OF COMPLIANCE LOCATION

- f U D f FAULT
- f U ? D f FAULT (INFERRED)
- f f FISSURE
- UBZ-1 GROUNDWATER ZONE

SOURCE:
AERIAL PHOTO FROM MONSANTO (5/2/2003).
SITE TOPOGRAPHY FROM AERIAL MAPPING, INC., IDAHO (5/11/1996).
WELL LOCATIONS BY GOLDER ASSOCIATES, (12/12/2001).

FIGURE **2**

WELL LOCATIONS AND FORMER SOURCE AREAS

MONSANTO/UBZ-2 SOURCE AREA WORK PLAN/ID

APPENDIX A
STATE OF IDAHO MONITORING WELL CONSTRUCTION REGULATIONS

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37.03.09 - Well Construction Standards Rules

IDAPA 37
TITLE 03
CHAPTER 09

37.03.09 - WELL CONSTRUCTION STANDARDS RULES

000. LEGAL AUTHORITY (RULE 0).
The Idaho Water Resource Board adopts these administrative rules with the authority provided by Section 42-238(12), Idaho Code. (5-8-09)

001. TITLE AND SCOPE (RULE 1).

01. Title. These rules are cited as IDAPA 37.03.09, "Well Construction Standards Rules." (5-8-09)

02. Scope. The Department of Water Resources has statutory responsibility for the statewide administration of the rules governing well construction. These rules establish minimum standards for the construction of all new wells and the modification and decommissioning (abandonment) of existing wells. The intent of the rules is to protect the ground water resources of the state against waste and contamination. These rules are applicable to all water wells, monitoring wells, low temperature geothermal wells, injection wells, cathodic protection wells, closed loop heat exchange wells, and other artificial openings and excavations in the ground that are more than eighteen (18) feet in vertical depth below land surface as described in these rules pursuant to Section 42-230 Idaho Code. Some artificial openings and excavations do not constitute a well. For the purposes of these rules, artificial openings and excavations not defined as wells are described in Subsection 045.03 of these rules. Any time that such an artificial opening or excavation is constructed, modified, or decommissioned (abandoned) the intent of these rules must be observed. If waste or contamination is attributable to this type of artificial opening or excavation, the artificial opening or excavation must be modified, or decommissioned (abandoned) as determined by the Director. (5-8-09)

002. WRITTEN INTERPRETATION (RULE 2).
In accordance with Section 67-5201(19)(b)(iv), Idaho Code, the Idaho Department of Water Resources may draft and implement written statements that pertain to the interpretation of these rules, or to the documentation of compliance with these rules. (5-8-09)

003. ADMINISTRATIVE APPEALS (RULE 3).
Persons may be entitled to appeal agency actions authorized under these rules pursuant to Section 42-1701A, Idaho Code, and IDAPA 37.01.01, "Rules of Procedure of the Idaho Department of Water Resources" (5-8-09)

004. INCORPORATION BY REFERENCE (RULE 4).
No documents have been incorporated by reference into this chapter. (5-8-09)

005. OFFICE HOURS -- MAILING ADDRESS AND STREET ADDRESS (RULE 5).

01. Office Hours. Office hours are 8 a.m. to 5 p.m. local time, Monday through Friday, except holidays designated by the state of Idaho. (5-8-09)

02. Mailing Address. The mailing address for the state office is: Idaho Department of Water Resources, P.0. Box 83720, Boise, Idaho 83720-0098. (5-8-09)

03. Street Address. The street addresses for the state office of the Department of Water Resources, the regional offices in Idaho Falls, Coeur d'Alene, Twin Falls, and Boise, and the satellite offices in Salmon, and Soda Springs may be obtained by calling the state office at (208) 287-4800, or by visiting the Department's website at http://www.idwr.idaho.gov. (5-8-09)

006. PUBLIC RECORDS ACT COMPLIANCE (RULE 6).
Records maintained by the Department of Water Resources are subject to the provisions of the Idaho Public Records Act, Title 9, Chapter 3, Sections 9-337 through 9-349, Idaho Code. (5-8-09)

007. -- 009. (RESERVED).

010. DEFINITIONS (RULE 10).
Unless the context otherwise requires, the following definitions apply to these rules. (5-8-09)

01. Approved Seal or Seal Material. Seal material must consist of bentonite chips, pellets, or granules, bentonite grout, neat cement, or neat cement grout as defined by these rules. No other materials may be used unless specifically authorized by the Director (5-8-09)

02. Annular Space. The space, measured as one-half (1/2) the difference in diameter between two (2) concentric cylindrical objects, one of which surrounds the other, such as the space between the walls of a drilled hole (borehole) and a casing or the space between two (2) strings of casing. (5-8-09)

03. Aquifer. Any geologic formation(s) that will yield water to a well in sufficient quantities to make the production of water from the formation feasible for beneficial use. (5-8-09)

04. Area of Drilling Concern. An area designated by the Director in which drillers must comply with additional standards to prevent waste or contamination of ground or surface water due to such factors as aquifer pressure, vertical depth of the aquifer, warm or hot ground water, or contaminated ground or surface waters, in accordance with Section 42-238(7), Idaho Code. (5-8-09)

05. Artesian Water. Any water that is confined in an aquifer under pressure so that the water will rise in the well casing or drilled hole above the elevation where it was first encountered. This term includes water of flowing and non-flowing wells. (5-8-09)

06. Artificial Filter Pack. Clean, rounded, smooth, uniform, sand or gravel placed in the annular space around a perforated well casing or well screen. A filter pack is frequently used to prevent the movement of finer material into the well casing and to increase well efficiency. (5-8-09)

07. Bentonite. A commercially processed and packaged, low permeability, sodium montmorillonite clay certified by the NSF International for use in well construction, sealing, plugging, and decommissioning (abandonment). All bentonite products used in the construction or decommissioning (abandoning) of wells must have a permeability rating not greater than 10^{-7} (ten to the minus seven) cm/sec. (5-8-09)

a. Chips. Bentonite composed of pieces ranging in size from one-quarter (1/4)-inch to one (1) inch on their greatest dimension. (5-8-09)

b. Granules (also Granular). Bentonite composed of pieces ranging in size from one thirty-seconds (1/32) inch (#20 standard mesh) to seven thirty-seconds (7/32) inch (#3 standard mesh) on their greatest dimension. (5-8-09)

c. Bentonite Grout. A mixture of bentonite specifically manufactured for use as a well sealing or plugging material and potable water to produce a grout with an active solids content not less than twenty-five percent (25%) by weight e.g., (twenty-five percent (25%) solids content by weight = fifty (50) pounds bentonite per eighteen (18) gallons of water). (5-8-09)

d. Pellets. Bentonite manufactured for a specific purpose and composed of uniform sized, one-quarter (1/4) inch, three-eighths (3/8) inch, or one-half (1/2) inch pieces on their greatest dimension. (5-8-09)

08. Board. The Idaho Water Resource Board. (7-1-93)

09. Bore Diameter. The diameter of the hole in the formation made by the drill bit or reamer. (7-1-93)

10. Borehole (also Well Bore). The subsurface hole created during the drilling process. (5-8-09)

11. Bottom Hole Temperature of an Existing or Proposed Well. The temperature of the ground water encountered in the bottom of a well or borehole. (5-8-09)

12. Casing. The permanent conduit installed in a well to provide physical stabilization, prevent caving or collapse of the borehole, maintain the well opening and serve as a solid inner barrier to allow for the installation of an annular seal. Casing does not include temporary surface casing, well screens, liners, or perforated casing as otherwise defined by these rules. (5-8-09)

13. Cathodic Protection Well. Any artificial excavation in excess of eighteen (18) feet in vertical depth constructed for the purpose of protecting certain metallic equipment in contact with the ground. Commonly referred to as cathodic protection. (7-1-93)

14. Closed Loop Heat Exchange Well. A ground source thermal exchange well constructed for the purpose of installing any underground system through which fluids are circulated but remain isolated from direct contact with the subsurface or ground water. (5-8-09)

15. Conductor Pipe. The first and largest diameter string of permanent casing to be installed in a low temperature geothermal resource well. (5-8-09)

16. Confining Layer. A subsurface zone of low-permeability earth material that naturally acts to restrict or retard the movement of water or contaminants from one zone to another. The term does not include topsoil. (5-8-09)

17. Consolidated Formations. Naturally-occurring geologic formations that have been lithified (turned to stone) such as sandstone and limestone, or igneous rocks such as basalt and rhyolite, and metamorphic rocks such as gneiss and slate. (5-8-09)

18. Contaminant. Any physical, chemical, ion, radionuclide, synthetic organic compound, microorganism, waste, or other substance that does not occur naturally in ground water or that naturally occurs at a lower concentration. (5-8-09)

19. Contamination. The introduction into the natural ground water of any physical, chemical, biological or radioactive material that may: (7-1-93)

a. Cause a violation of Idaho Ground Water Quality Standards; or (5-8-09)

b. Adversely affect the health of the public; or (7-1-93)

c. Adversely affect a designated or beneficial use of the State's ground water. Contamination includes the introduction of heated or cooled water into the subsurface that will alter the ground water temperature and render the local ground water less suitable for beneficial use, or the introduction of any contaminant that may cause a violation of IDAPA 58.01.11, "Ground Water Quality Rule." (5-8-09)

20. Decommissioned (Abandoned) Well. Any well that has been permanently removed from service and filled or plugged in accordance with these rules so as to meet the intent of these rules. A properly decommissioned well will not: (5-8-09)

a. Produce or accept fluids; (5-8-09)

b. Serve as a conduit for the movement of contaminants inside or outside the well casing; or (5-8-09)

c. Allow the movement of surface or ground water into unsaturated zones, into another aquifer, or between aquifers. (5-8-09)

21. Decontamination. The process of cleaning equipment intended for use in a well in order to prevent the introduction of contaminants into the subsurface and contamination of natural ground water. (5-8-09)

22. Department. The Idaho Department of Water Resources. (7-1-93)

23. **Dewatering Well**. A well constructed for the purpose of improving slope stability, drying up borrow pits, or intercepting seepage that would otherwise enter an excavation. (5-8-09)

24. **Director**. The Director of the Idaho Department of Water Resources or his duly authorized representatives. (7-1-93)

25. **Disinfection**. The introduction of chlorine or other agent or process approved by the Director in sufficient concentration and for the time required to inactivate or kill fecal and Coliform bacteria, indicator organisms, and other potentially harmful pathogens. (5-8-09)

26. **Draw Down**. The difference in vertical distance between the static water level and the pumping water level. (5-8-09)

27. **Drive Point (also known as a Sand Point)**. A conduit pipe or casing through which ground water of any temperature is sought or encountered created by joining a "drive point unit" to a length of pipe and driving the assembly into the ground. (5-8-09)

28. **Exploratory Well**. A well drilled for the purpose of discovering or locating new resources in unproven areas. They are used to extract geological, hydrological, or geophysical information about an area. (5-8-09)

29. **Global Positioning System (GPS)**. A global navigational receiver unit and satellite system used to triangulate a geographic position. (5-8-09)

30. **Hydraulic Conductivity**. A measurement of permeability. (5-8-09)

31. **Hydraulic Fracturing**. A process whereby water or other fluid is pumped under high pressure into a well to further fracture the reservoir rock or aquifer surrounding the production zone of a well to increase well yield. (5-8-09)

32. **Injection Well**. Any excavation or artificial opening into the ground which meets the following three (3) criteria: (7-1-93)

a. It is a bored, drilled or dug hole, or is a driven mine shaft or driven well point; and (7-1-93)

b. It is deeper than its largest straight-line surface dimension; and (7-1-93)

c. It is used for or intended to be used for subsurface placement of fluids. (7-1-93)

33. **Intermediate String or Casing**. The casing installed and sealed below the surface casing within a low temperature geothermal resource well to isolate undesirable water or zones below the bottom of the surface casing. Such strings may either be lapped into the surface casing or extend to land surface. (5-8-09)

34. **Liner**. (5-8-09)

a. A conduit pipe that can be removed from the borehole or well that is used to serve as access and protective housing for pumping equipment and provide a pathway for the upward flow of water within the well. (5-8-09)

b. Liner does not include casing required to prevent caving or collapse, or both, of the borehole or serve as a solid inner barrier to allow for the installation of an annular seal. (5-8-09)

35. **Mineralized Water**. Any naturally-occurring ground water that has an unusually high amount of chemical constituents dissolved within the water. Water with five thousand (5000) mg/L or greater total dissolved solids is considered mineralized. (5-8-09)

36. **Modify**. To deepen a well, increase or decrease the diameter of the casing or the well bore, install a

liner, place a screen, perforate existing casing or liner, alter the seal between the casing and well bore, or alter the well to not meet well construction standards. (5-8-09)

37. Monitoring Well. Any well more than eighteen (18) feet in vertical depth constructed to evaluate, observe or determine the quality, quantity, temperature, pressure or other characteristics of the ground water or aquifer. (7-1-93)

38. Neat Cement. A mixture of water and cement in the ratio of not more than six (6) gallons of water to ninety-four (94) pounds of Portland cement (neat cement). Other cement grout mixes may be used if specifically approved by the Director. (5-8-09)

39. Neat Cement Grout. Up to five percent (5%) bentonite by dry weight may be added per sack of cement (neat cement grout) and the water increased to not more than six and one-half (6.5) gallons per sack of cement. Other neat cement mixes may be used if specifically approved by the Director. These grouts must be mixed and installed in accordance with the American Petroleum Institute Standards - API Class A through H. As found in API RP10B, "Recommended Practice for Testing Oil Well Cements and Cement Additives," current edition or other approved standards. (5-8-09)

40. Oxidized Sediments. Sediments, characterized by distinct coloration, typically shades of brown, red, or tan, caused by the alteration of certain minerals in an environment with a relative abundance of oxygen. (5-8-09)

41. Perforated Well Casing. Well casing that has been modified by the addition of openings created by drilling, torch cutting, saw cutting, mechanical down-hole perforator, or other method. (5-8-09)

42. Pitless Adaptor or Pitless Unit. An assembly of parts designed for attachment to a well casing which allows buried pipe to convey water from the well or pump and allows access to the interior of the well casing for installation or removal of the pump or pump appurtenances, while maintaining a water tight connection through the well casing and preventing contaminants from entering the well. (5-8-09)

43. Potable Water. Water of adequate quality for human consumption. (5-8-09)

44. Pressure Grouting (Grouting). The process of pumping and placing an approved grout mixture into the required annular space, by positive displacement from bottom to top using a tremie pipe, Halliburton method, float shoe, or other method approved by the Director. (5-8-09)

45. Production Casing. The casing or tubing through which a low temperature geothermal resource is produced. This string extends from the producing zone to land surface. (5-8-09)

46. Public Water System. A system for the provision to the public of water for human consumption through pipes or, after August 5, 1998, other constructed conveyances, if such system has at least fifteen (15) service connections, regardless of the number of water sources or configuration of the distribution system, or regularly serves an average of at least twenty-five (25) individuals daily at least sixty (60) days out of the year. Such term includes: (5-8-09)

a. Any collection, treatment, storage, and distribution facilities under the control of the operator of such system and used primarily in connection with such system; and (5-8-09)

b. Any collection or pretreatment storage facilities not under such control that are used primarily in connection with such system. (5-8-09)

c. Such term does not include any "special irrigation district." (5-8-09)

d. A public water system is either a "community water system" or a "non-community water system." (5-8-09)

47. Reduced Sediments. Sediments, characterized by distinct coloration, typically shades of blue,

black, gray, or green, caused by the alteration of certain minerals in an oxygen poor environment. (5-8-09)

48. Remediation Well. A well used to inject or withdraw fluids, vapor, or other solutions approved by the Director for the purposes of remediating, enhancing quality, or controlling potential or known contamination. Remediation wells include those used for air sparging, vapor extraction, or injection of chemicals for remediation or in-situ treatment of contaminated sites. (5-8-09)

49. Sand. Any sediment particle retained on a U.S. standard sieve #200 (Seventy-five hundreths (0.075) mm to two (2) mm). (5-8-09)

50. Screen (Well Screen). A commercially produced structural tubular retainer with standard sized openings to facilitate production of sand free water. (5-8-09)

51 Seal or Sealing. The placement of approved seal material in the required annular space between a borehole and casing, between casing strings, or as otherwise required to create a low permeability barrier and prevent movement or exchange of fluids. Seals are required in the construction of new wells, repair of existing wells, and in the decommissioning (abandonment) of wells. Seals are essential to the prevention of waste and contamination of ground water. (5-8-09)

52. Start Card. An expedited drilling permit process for the construction of cold water, single-family residential wells. (5-8-09)

53. Static Water Level. The height at which water will rise in a well under non-pumping conditions. (5-8-09)

54. Surface Casing. The first string of casing in a low temperature geothermal resource well which is set and sealed after the conductor pipe to anchor blow out prevention equipment and to case and seal out all existing cold ground water zones. (5-8-09)

55. Temporary Surface Casing. Steel pipe used to support the borehole within unstable or unconsolidated formations during construction of a well that will be removed following the installation of the permanent well casing and prior to or during placement of an annular seal. (5-8-09)

56. Thermoplastic/PVC Casing. Plastic piping material meeting the requirements of ASTM F 480 and specifically designed for use as well casing. (5-8-09)

57. Transmissivity. The capacity of an aquifer to transmit water through its entire saturated thickness. (5-8-09)

58. Tremie Pipe. A small-diameter pipe used to convey grout, dry bentonite products, or filter pack materials into the annular space, borehole, or well from the bottom to the top of a borehole or well. (5-8-09)

59. Unconfined Aquifer. An aquifer in which the water table is in contact with and influenced by atmospheric pressure through pore spaces in the overlying formation(s). (5-8-09)

60. Unconsolidated Formation. A naturally-occurring earth formation that has not been lithified. Alluvium, soil, sand, gravel, clay, and overburden are some of the terms used to describe this type of formation. (7-1-93)

61. Unstable Unit. Unconsolidated formations, and those portions of consolidated formations, that are not sufficiently hard or durable enough to sustain an open borehole without caving or producing obstructions without the aid of fluid hydraulics or other means of chemical or physical stabilization. (5-8-09)

62. Unusable Well. Any well that can not be used for its intended purpose or other beneficial use authorized by law. (5-8-09)

63. Waiver. Approval in writing by the Director of a written request from the well driller and the well

owner proposing specific variance from the minimum well construction standards. (5-8-09)

64. Waste. The loss, transfer, or subsurface exchange of a ground water resource, thermal characteristic, or natural artesian pressure from any aquifer caused by improper construction, misuse, or failure to properly maintain a well. Waste includes: (5-8-09)

a. The flow of water from an aquifer into an unsaturated subsurface zone; (5-8-09)

b. The transfer or mixing, or both, of waters from one aquifer to another (aquifer commingling); or (5-8-09)

c. The release of ground water to the land surface whenever such release does not comply with an authorized beneficial use. (5-8-09)

65. Water Table. The height at which water will rise in a well; also the upper surface of the zone of saturation in an unconfined aquifer. This level will change over time due to changes in water supply and aquifer impacts. (5-8-09)

66. Well. (5-8-09)

a. An artificial excavation or opening in the ground more than eighteen (18) feet in vertical depth below land surface by which ground water of any temperature is sought or obtained. The depth of a well is determined by measuring the maximum vertical distance between the land surface and the deepest portion of the well. Any water encountered in the well is considered to be obtained for the purpose of these rules; or (5-8-09)

b. Any waste disposal and injection well, as defined in Section 42-3902, Idaho Code. (5-8-09)

c. Well does not mean: (5-8-09)

i. A hole drilled for mineral exploration; or (5-8-09)

ii. Holes drilled for oil and gas exploration which are subject to the requirements of Section 47-320, Idaho Code; or (5-8-09)

iii. Holes drilled for the purpose of collecting soil samples above the water table. (5-8-09)

67. Well Development. The act of bailing, jetting, pumping, or surging water in a well to remove drilling fluids, fines, and suspended materials from within a completed well and production zone in order to establish the optimal hydraulic connection between the well and the aquifer. (5-8-09)

68. Well Driller or Driller. Any person who operates drilling equipment, or who controls or supervises the construction of a well, and is licensed under Section 42-238, Idaho Code (5-8-09)

69. Well Drilling or Drilling. The act of constructing a new well or modifying or changing the construction of an existing well. (5-8-09)

70. Well Owner. Any person, firm, partnership, co-partnership, corporation, association, or other entity, or any combination of these, who owns the property on which the well is or will be located or has secured ownership of the well by means of a deed, covenant, contract, easement, or other enforceable legal instrument for the purpose of benefiting from the well. (5-8-09)

71. Well Rig (Drill Rig). Any power driven percussion, rotary, boring, digging, jetting or auguring machine used in the construction of a well. (5-8-09)

011. -- 024. (RESERVED).

025. CONSTRUCTION OF COLD WATER WELLS (RULE 25).

All persons constructing wells must comply with the requirements of Section 42-238, Idaho Code, and IDAPA 37.03.10, "Well Driller Licensing Rules." The standards specified in Rule 25 apply to all wells with a bottom hole temperature of eighty-five (85) degrees Fahrenheit or less. Wells with a bottom hole temperature greater than eighty-five (85) degrees Fahrenheit, but less than two hundred twelve (212) degrees Fahrenheit, must meet the requirements of Rule 30 in addition to meeting the requirements of Rule 25. These standards also apply to any waste disposal and injection well as defined in Section 42-3902, Idaho Code. (5-8-09)

01. General. The well driller must construct each well as follows: (5-8-09)

a. In accordance with these rules and with the conditions of approval of any drilling permit issued pursuant Section 42-235, Idaho Code, and in a manner that will prevent waste and contamination of the ground water resources of the state of Idaho. The adopted standards are minimum standards which must be adhered to in the construction of all new wells, and in the modification or decommissioning (abandonment) of existing wells. The well driller is charged with the responsibility of preventing waste or contamination of the ground water resources during the construction, modification or abandonment of a well. The Director may add conditions of approval to a drilling permit issued pursuant to Rule 45 of these rules to require that a well be constructed, modified, or decommissioned (abandoned) in accordance with additional standards when necessary to protect ground water resources and the public health and safety from existing contamination and waste or contamination during the construction, modification or decommissioning (abandonment) of a well. (5-8-09)

b. In consideration of the geologic and ground water conditions known to exist or anticipated at the well site. (5-8-09)

c. Such that it is capable of producing, where obtainable, the quantity of water to support the allowed or approved beneficial use of the well, subject to law; (5-8-09)

d. Meet the siting and separation distance requirements in the table in this Subsection (025.01.d.). Additional siting and separation distance requirements are set forth by the governing district health department and the Idaho Department of Environmental Quality rules at IDAPA 58.01.03, "Individual/Subsurface Sewage Disposal Rules," and IDAPA 58.01.08, "Idaho Rules for Public Drinking Water Systems".

Separation of Well from:		Minimum Separation Distance (feet)
Existing Public Water Supply well, separate ownership	-	50
Other existing well, separate ownership	-	25
Septic drain field	-	100
Septic tank	-	50
Drainfield of system with more than 2,500 GPD of sewage inflow	-	300*
Sewer line - main line or sub-main, pressurized, from multiple sources	-	100
Sewer line - main line or sub-main, gravity, from multiple sources	-	50
Sewer line - secondary, pressure tested, from a single residence or building	-	25
Effluent pipe	-	50
Property line	-	5
Permanent buildings, other than those to house the well or plumbing apparatus, or both	-	10
Above ground chemical storage tanks	-	20
Permanent (more than six months) or intermittent (more than two months) surface water	-	50

Separation of Well from:		Minimum Separation Distance (feet)
Canals, irrigation ditches or laterals, & other temporary (less than two months) surface water	-	25
*This distance may be less if data from a site investigation demonstrates compliance with IDAPA 58.01.03, "Individual/Subsurface Sewage Disposal Rules," separation distances.		

(5-8-09)

02. Waivers. In unique cases where the Director concludes that the ground water resources will be protected against waste and contamination and the public health and safety are not compromised, a waiver of specific standards required by these rules may be approved prior to constructing, decommissioning, or modifying a well. (5-8-09)

a. To request a waiver the well driller and well owner must: (5-8-09)

i. Jointly submit a detailed plan and written request identifying a specific Rule or Rules proposed to be waived. Additionally, the plan must detail the well construction process that will be employed in lieu of complete Rule compliance: (5-8-09)

ii. Prior to submittal, the well driller and the well owner must sign the plan and written request acknowledging concurrence with the request; and (5-8-09)

iii. Submit the plan and request by facsimile, e-mail, or letter. (5-8-09)

b. The Director will evaluate and respond to the request within ten (10) business days of receiving the request. (5-8-09)

i. If the request for waiver is approved, the intent of the rules will be served and all standards not waived will apply. Waivers approved by the Director will not supersede requirements of other regulatory agencies without specific concurrence from that agency. Work activity related to a waiver request will not proceed until a written or verbal approval is granted by the Director. (5-8-09)

ii. Any verbal approval will be followed by a written approval. (5-8-09)

03. Records. In order to enable a comprehensive survey of the extent and occurrence of the state's ground water resource, the coordinates of every newly constructed, modified or decommissioned (abandoned) well location must be identified by latitude and longitude with a global positioning system (GPS) and recorded on the driller's report in degrees and decimal minutes and within the nearest 40 acre parcel using the Public Land Survey System. Every well driller must maintain records as described in IDAPA 37.03.10 "Well Driller Licensing Rules," pursuant to Section 42-238(11), Idaho Code, and provide the well owner with a copy of the approved well drilling permit and a copy of the well driller's report when submitted to the Director. (5-8-09)

04. Casing. The well driller must install casing in every well. Steel or thermoplastic casing may be installed in any well with a bottom hole temperature of eighty-five (85) degrees Fahrenheit or less. Thermoplastic pipe must not be installed in a well with a bottom hole temperature greater than eighty-five (85) degrees Fahrenheit. All casing to be installed must be new or in like-new condition, free of defects, and clearly marked by the manufacturer with all specifications required by these rules. For all wells the casing must extend at least twelve (12) inches above land surface and finished grade and to a minimum depth below land surface as required by these rules. Concrete slabs around a well casing will be considered finished grade (Figure 01, Appendix A).The well driller must install casing of sufficient strength to withstand calculated and anticipated subsurface forces and corrosive effects. The well driller must install casings sufficiently plumb and straight to allow the installation or removal of screens, liners, pumps and pump columns without causing adverse effects on the operation of the installed pumping

equipment. (5-8-09)

a. Steel Casing. When steel casing lengths are joined together, they must be joined by welded joints or screw-couple joints. All connection must be water tight. If steel casing joints are welded, the weld must be at least as thick as the well casing and fully penetrating. Welding rods or flux core wire of at least equal quality to the casing metal must be used. Casing ends to be joined by welding must be properly prepared, beveled and gapped to allow full penetration of the weld. All stick welded joints must have a minimum of two (2) passes including a "root" pass and have minimal undercut when complete. (5-8-09)

i. In addition to meeting these standards, all wells that are constructed for public water systems must meet all of the casing wall thickness requirements set forth by the Idaho Department of Environmental Quality Rules, IDAPA 58.01.08, "Idaho Rules for Public Drinking Water Systems." (5-8-09)

ii. The well driller must install steel casing that meets or exceeds the American Society of Testing and Materials (ASTM) standard A53, Grade B or American Petroleum Institute (API) 5L Grade B, and that meets the following specifications for wall thickness:

Minimum Single-Wall Steel Well Casing Thickness1 for Selected Diameters (inches)

Nominal Diameter (in.)[3]	**6**[2]	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**
Depth (ft.)	Nominal Wall Thickness (in.)[1]												
<100	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
100-200	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
200-300	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
300-400	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.375	0.375	0.375	0.375
400-600	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.375	0.375	0.375	0.375	0.375
600-800	0.250	0.250	0.250	0.250	0.250	0.250	0.375	0.375	0.375	0.375	0.375	0.375	0.375
800-1000	0.250	0.250	0.250	0.250	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
1000-1500	0.280	0.322	0.365	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
1500-2000	0.280	0.322	0.365	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375

1 Compliance with the minimum nominal wall thicknesses listed is required for any depth or location where casing is used to prevent caving or collapse, or both, of the borehole or serves as a solid inner barrier to allow for the installation of an annular seal.

2 For nominal casing diameters less than six (6) inches, the minimum nominal wall thickness must be equivalent to ASTM Schedule 40.

3 For any other casing diameter not addressed herein, prior approval by the Director is required.

b. Thermoplastic Casing. Thermoplastic casing may be used in monitoring wells and cold water wells if drilling of the borehole confirms its suitability for use. (5-8-09)

i. Thermoplastic casing must conform to ASTM F 480 and NSF-WC. The well driller must not use thermoplastic casing under any condition where the manufacturer's resistance to hydraulic collapse pressure (RHCP) or total depth specifications are exceeded. Thermoplastic casing extending above-ground must be protected from physical and ultraviolet light damage by enclosing it within steel casing extending at least twelve (12) inches above land surface and finished grade and to a minimum depth of eighteen (18) feet below land surface or five (5) feet

below land surface for monitoring wells. (5-8-09)

ii. Thermoplastic pipe used in wells as casing or liner must have a minimum rating of SDR-21. For nominal diameters of four (4) inches or less, a minimum rating of Schedule 40 is required. If used as casing within unconsolidated or unstable consolidated formations, thermoplastic pipe must be centralized and fully supported throughout the unstable zone(s) with filter pack or seal material as required by these rules. (5-8-09)

iii. All thermoplastic casing and liner must be installed in accordance with the manufacturer's recommendations and specifications, and as required by these rules. The well driller will not treat thermoplastic pipe in any manner that would adversely affect its structural integrity. The well driller must: (5-8-09)

(1) Ensure that the weight of the pump assembly, if secured to the thermoplastic pipe, does not exceed the weight limitations per manufacturer's recommendations or cause damage to the pipe resulting in breaks or leaks. (5-8-09)

(2) Not use Type III (high-early strength) Portland cement-based seal materials in direct contact with thermoplastic pipe unless approved by the Director. (5-8-09)

(3) Not drive, drop, force, or jack thermoplastic pipe into place. Thermoplastic pipe must be lowered or floated into an oversized, obstruction-free borehole. (5-8-09)

c. Perforated Well Casing. Perforated well casing may be used in the construction or decommissioning of a well when such application does not violate any standards required by these rules. (5-8-09)

05 Liner. In addition to well casing, liners may be installed in wells to prevent damage to pumping equipment. Steel or thermoplastic pipe may be installed as liner in a well with a bottom hole temperature of eighty-five (85) degrees Fahrenheit or less. Thermoplastic liner must conform to ASTM F 480 and NSF-WC. Thermoplastic liners must not be used in unconsolidated formations or unstable units. (5-8-09)

06. Screen. Well screens must be used in constructing a well when necessary to avoid sand production (see sand production, Rule 25, Subsection 025.24). Well screens must be commercially manufactured, be slotted, louvered or wire wrapped, and be installed according the manufacturers specifications. (5-8-09)

a. Screens may require a filter pack consisting of sand or gravel to further reduce the quantity of sand produced from the well. (5-8-09)

b. The well driller will not install well screens, perforated casing or filter pack across a confining layer(s) separating aquifers of different pressure, temperature, or quality. (5-8-09)

07. Use of Approved Sealing Materials and Required Annular Space. Well casings must be sealed in the required annular space with approved material to prevent the possible downward movement of contaminated surface waters or other fluids in any annular space around the well casing (Figure 02, Appendix A). Proper sealing is also required to prevent the movement of groundwater either upward or downward from zones of different pressure, temperature or quality within the well or outside the casing. The well driller must notify by phone the Department's appropriate Region Office at least four (4) hours in advance of placing any annular seal to provide Department staff the opportunity to observe seal placement. (5-8-09)

a. All casing to be sealed must be adequately centralized to ensure uniform seal thickness around the well casing. Surface seals must extend to not less than thirty-eight (38) feet below land surface for well depths greater than thirty-eight (38) feet. For well depths less than thirty-eight (38) feet, seals must extend to depths as hereafter required. (5-8-09)

b. Seals are required at depths greater than thirty-eight (38) feet in artesian wells or to seal through confining layers separating aquifers of differing pressure, temperature, or quality in any well. (5-8-09)

c. When a well is modified and the existing casing is moved or the original seal is damaged, or a well driller discovers that a seal was not installed or has been damaged, the well driller must repair, replace, or install a

seal around the permanent casing that is equal to or better than required when the well was originally constructed. (5-8-09)

d. Manufactured packers and shale traps may be used as devices to retain approved seal material when installing a required annular seal. Whenever these devices are used to retain seal material, the well driller must comply with the manufacturer's recommendations for installation. (5-8-09)

e. If a temporary casing has been installed, upon completion of the drilling, the annular space must be filled with approved seal material and kept full while withdrawing the temporary casing. Bentonite chips should be used with caution when the annular space between a temporary casing and permanent casing is filled with water. (5-8-09)

i. When attempts at removing a temporary casing are unsuccessful, the casing must be sealed in place by a method approved by the department. (5-8-09)

ii. The well driller must notify the department whenever a temporary casing can not be removed and propose a plan to adequately seal the casing to prevent waste and contamination of the ground water. The plan must detail how the casing will be sealed on the outside to a sufficient depth below land surface in addition to placement of any required formation seals through the interval at which the casing will remain. (5-8-09)

f. For mixed grout seals the minimum annular space required must provide for a uniform seal thickness not less than one (1) inch on all sides of the casing or a borehole at least two (2) inches larger than the outside diameter (OD) of the casing to be sealed (Figure 02, Appendix A). (Note: a seven and seven-eighths (7 7/8) inch diameter (eight (8) inch nominal) borehole around a six and five-eighths (6 5/8) inch OD (six (6) inch nominal casing does not satisfy the minimum annular space requirements). (5-8-09)

i. When placing grout seals with a removable tremie pipe between casing strings or between a borehole and casing, the required annular space must be at least one (1) inch or equal to the OD of the tremie pipe whichever is greater. Permanent tremie pipes will be considered as a casing string and subject to minimum annular space requirements in addition to the annular space requirements around the well casing (Figure 03, Appendix A). (5-8-09)

ii. All grout seals must be placed from the bottom up, by using an approved method. Bentonite grout must not be used above the water table unless specifically designed and manufactured for such use and approved by the Director in advance. (5-8-09)

iii. If cement-based grout (neat cement or neat cement grout) is used to create a seal, the casing string sealed must not be moved or driven after the initial set. Construction must not resume for a minimum of twenty-four (24) hours following seal placement; (5-8-09)

g. For dry bentonite seals the minimum annular space required must provide for a uniform seal thickness not less than one and five-eighths (1 5/8) inches on all sides of the casing or a borehole at least four (4) inches larger than the "nominal diameter" of the casing to be sealed. e.g., (six and five-eighths (6 5/8) inch OD (six (6) inch nominal) casing requires a ten and three fourths (10 3/4) inch OD (ten (10) inch nominal) temporary casing or a nine and seven-eighths (9 7/8) inch (ten (10) inch nominal) minimum borehole). Listed below are additional annular space requirements and limitations for placement of dry bentonite seals: (5-8-09)

i. All dry bentonite seals must be tagged during placement and consider volumetric calculations to verify placement. (5-8-09)

ii. Installation of dry bentonite seals must be consistent with the manufacturers' recommendations and specifications for application and placement. (5-8-09)

iii. Granular bentonite must not be placed through water. (5-8-09)

iv. If a granular bentonite seal is placed deeper than two hundred (200) feet, the minimum annular space must be increased by at least one (1) inch e.g., (six and five-eighths (6 5/8) inch OD (six (6) inch nominal)

casing requires a twelve and three fourths (12 3/4) inch OD (twelve (12) inch nominal) temporary casing or an eleven and seven eights (11 7/8) inch (twelve (12) inch nominal) minimum borehole). (5-8-09)

v. Bentonite chips may be placed through water or drilling fluid of appropriate viscosity. Bentonite chip seals placed through more than fifty (50) feet of water or drilling fluid will require the minimum annular space to be increased by at least one (1) inch e.g., (six and five-eighths (6 5/8) inch OD (six (6) inch nominal) casing requires a twelve and three fourths (12 3/4) inch OD (twelve (12) inch nominal) temporary casing or an eleven and seven eights (11 7/8) inch (twelve (12) inch nominal) minimum borehole). (5-8-09)

08. Sealing of Wells. Sealing requirements described herein are minimum standards that apply to all wells. The Director may establish alternate minimum sealing requirements in specific areas when it can be determined through detailed studies of the local hydrogeology that a specific alternate minimum will provide protection of the ground water from waste and contamination. (5-8-09)

a. Consolidated Formations. When a water well is drilled into and acquires water from an aquifer that consists of consolidated formations that are above the water table, casing must be installed so that it extends and is sealed to a depth not less than thirty-eight (38) feet (Figure 04, Appendix A). If the well depth is less than thirty-eight (38) feet from land surface, well casing must be installed and sealed five (5) feet into the consolidated formation or to a depth of eighteen (18) feet, whichever is greater. (5-8-09)

b. Unconsolidated Formations without Confining Layers of Clay. When a water well is drilled into and acquires water from an unconfined aquifer that is overlain with unconsolidated formations, such as sand and gravel without confining layers of clay, well casing must extend to at least five (5) feet below the water table and be sealed to a depth not less than thirty-eight (38) feet (Figure 05, Appendix A). If the well depth is less than thirty-eight (38) feet well casing must extend to at least five (5) feet below the water table or eighteen (18) feet, whichever is greater, and be sealed to a depth of at least eighteen (18) feet. (5-8-09)

i. The extensive (for example, one hundred fifty (150) feet thick or more) unconsolidated, non-stratified, sand and gravel of the Rathdrum Prairie are characterized by extremely high transmissivity and hydraulic conductivity. Under these conditions, sealing wells to depths greater than eighteen (18) feet may not be additionally protective. When a water well is drilled within the boundaries of the Rathdrum Prairie, (shown in Figure 06, Appendix A of these rules), well casing must extend to at least five (5) feet below the water table and be sealed to a depth not less than eighteen (18) feet (Figure 07, Appendix A). (5-8-09)

c. Unconsolidated Formations with Confining Layers of Clay. When a well is drilled into and acquires water from an aquifer that is overlain by unconsolidated deposits such as sand and gravel, and there are confining layers of clay above the water table, well casing must be installed from the land surface to the confining layer immediately above and in contact with the production zone and sealed to a depth not less than thirty-eight (38) feet (Figure 08, Appendix A). If the well depth is less than thirty-eight (38) feet from land surface, well casing must extend and be sealed into the first confining layer or to a depth of eighteen (18) feet, whichever is greater. (5-8-09)

09. Sealing Artesian Wells. (5-8-09)

a. Unconsolidated Formations. When artesian water is encountered in unconsolidated formations, the production zone or open interval must be limited to zones of like pressure, temperature, and quality. Water encountered in oxidized sediments must not be comingled with water encountered in reduced sediments. Well casing must extend from land surface into the lower most confining layer above the production zone, and must be sealed: (5-8-09)

i. From land surface to a depth of at least thirty-eight (38) feet; and (5-8-09)

ii, Through all confining layer(s); and (5-8-09)

(1) A minimum of five (5) feet of seal material must be placed into or through the lower most confining layer above the production zone (Figure 09, Appendix A); or (5-8-09)

(2) Five (5) feet into or through the lowermost confining layer above the production zone and continuously to land surface (Figure 09, Appendix A). (5-8-09)

iii. If the well depth is less than thirty-eight (38) feet, the well must be cased and sealed from land surface to the confining layer in direct contact with the production zone or to a depth of eighteen (18) feet, whichever is greater. (5-8-09)

b. Consolidated Formations. When artesian water is encountered in a consolidated formation, well casing must be installed and sealed from land surface to a depth of at least thirty-eight (38) feet; and (5-8-09)

i. If the consolidated formation is overlain by a permeable formation(s) and water will rise above the consolidated formation, well casing must extend and be sealed at least five (5) feet into the confining portion of the consolidated formation (Figure 10, Appendix A). (5-8-09)

ii. If the well depth is less than thirty-eight (38) feet, the well must be cased and sealed from land surface five (5) feet into the confining consolidated formation or to a depth of eighteen (18) feet, whichever is greater. (5-8-09)

c. Control Device. Pursuant to Section 42-1603, Idaho Code, if the well flows at land surface, it must be equipped with a control device approved by the Director, so that the flow can be completely stopped. If leaks occur around the well casing or adjacent to the well, the well must be completed with seals, casing or cement grout to eliminate the leakage. (5-8-09)

i. Flowing artesian wells must be equipped with an approved pressure gage fitting that will allow access for measurement of shut-in pressure of a flowing well. All pressure gage fittings must include control valves such that the pressure gage can be removed without resulting in artesian flow from the well. (5-8-09)

ii. The well driller must not move his well drilling rig from the site until all requirements have been satisfied. Some mixing of water may be allowed to develop an adequate water well; however, the mixing must be restricted to water zones of similar pressure, temperature and quality. The driller must take precautions to case and seal out zones which may lead to waste or contamination. (5-8-09)

10. Alternative Methods for Sealing Wells. To accommodate for new technology, and in consideration of the wide variety of drilling equipment used to construct wells, other methods of sealing wells not specifically addressed in these rules may be allowed. The Director may consider specific proposals for alternative methods of sealing on a case by case basis. Director approval or acceptance of such procedures will not constitute a "waiver" of any requirements of these rules. In such cases, the well driller must provide sufficient information for the Director to determine that the full intent of the sealing requirements will be satisfied if an alternative method is employed. If it is determined that a specific alternate method will provide protection of the ground water from waste and contamination, the Director may issue a statement of acceptance qualifying the use and implementation of such methods. (5-8-09)

11. Injection Wells. In addition to meeting the requirements of Rule 25 of these rules, the construction, modification, or decommissioning (abandonment) of all injection wells over eighteen (18) feet in vertical depth must also comply with the IDAPA 37.03.03, "Rules for the Construction and Use of Injection Wells," and the injection well permit. Drillers must obtain from the Director a certified copy of the permit authorizing construction or modification of an injection well before beginning work. (5-8-09)

12. Cathodic Protection Wells. All cathodic protection wells must be constructed by a licensed well driller in compliance with these rules. A detailed construction plan must be included with the drilling permit application. (5-8-09)

13. Monitoring and Remediation Wells. All monitoring wells and remediation wells must be constructed and maintained in a manner that will prevent waste or contamination and as otherwise required by these rules. When a monitoring well or a remediation well is no longer useful or needed, the owner or operator of the well must decommission (abandon) the well in accordance with Rule 25, Subsection 025.16 of these rules. No person may divert ground water from a monitoring well or a remediation well for any purpose not authorized by the Director. The

application for a permit for all monitoring wells and all remediation wells must include a design proposal prepared by a licensed engineer or registered geologist pursuant to Section 42-235, Idaho Code. Blanket permits for monitoring well and remediation well networks may be approved for site-specific monitoring and remediation programs. The designs and specification for monitoring wells and remediation wells must demonstrate that: (5-8-09)

a. The ground water resources are protected against waste and contamination; (5-8-09)

b. The well(s) will inject or withdraw only fluids, gasses or solutions approved by the Director; (5-8-09)

c. The well(s) will be constructed so as to prevent aquifer commingling; and (5-8-09)

d. The well(s) will be properly decommissioned (abandoned) upon project completion and in accordance with these rules. (5-8-09)

14. Closed Loop Heat Exchange Wells. The well driller must construct closed loop heat exchange wells consistent with these rules. The well driller is not required to install steel casing in such wells. When constructing a closed loop heat exchange well, the well driller must: (5-8-09)

a. Construct each borehole of sufficient size to provide the annular space required by these rules. (5-8-09)

b. Seal the annular space of each borehole with approved seal material in accordance with these rules; (5-8-09)

c. Install fluid-tight circulating pipe, composed of high-density polyethylene, grade PE3408, minimum cell classifications PE355434C or PE345434C conforming to ASTM Standard D3350, or other Director-approved pipe; (5-8-09)

d. Join pipe using thermal fusion techniques according to ASTM Standards D-3261 or D-2683. All personnel creating such system joints must be trained in the appropriate thermal fusion technologies; (5-8-09)

e. Use only propylene glycol, or other circulating fluid approved by the Director; (5-8-09)

f. Ensure that any other system additive is NSF approved and has prior approval from the Director; (5-8-09)

g. Pressure test each loop with potable water prior to grout installation; (5-8-09)

h. Pressure test the system with potable water prior to installation of the circulating fluid at one hundred percent (100%) of the designed system operating pressure for a minimum duration of twenty-four (24) hours; and (5-8-09)

i. Properly repair or decommission (abandon) all loops failing the test by pressure pumping approved seal material through the entire length of each failed loop. After grouting, loop ends must be fused together or capped. (5-8-09)

15. Access Port or Pressure Gage. Upon completion of a well and before removal of the well rig from the site, the well must be equipped with an access port that will allow for measurement of the depth to water or an approved pressure gage fitting that will allow access for measurement of shut-in pressure of an artesian flowing well. All pressure gage fittings must include control valves such that the pressure gage can be removed. Approved access ports are illustrated in Figure 11, APPENDIX A, together with approved locations for pressure gage fittings. Air lines are not a satisfactory substitution for an access port. Nonflowing domestic and stock water wells that are to be equipped with a sanitary seal with a built-in access port are exempt from this requirement. (5-8-09)

16. Decommissioning (Abandoning) of Wells. (5-8-09)

a. The well owner is charged with maintaining and properly decommissioning (abandoning) a well in a manner that will prevent waste or contamination, or both, of the ground water. No person is allowed to decommission a well in Idaho without first obtaining a driller's license or receiving a waiver of the license requirement from the Director of the Department of Water Resources. Authorization is required from the Director prior to decommissioning any well. Upon decommissioning, the person who decommissioned the well must submit to the Director a report describing the procedure. (5-8-09)

b. The Director may require decommissioning of a well in compliance with the provisions of these rules, if the well: (5-8-09)

i. Does not meet minimum well construction standards; (5-8-09)

ii. Meets the definition of an unusable well; (5-8-09)

iii. Poses a threat to human health and safety; (5-8-09)

iv. Is in violation of IDAPA 58.01.11, "Ground Water Quality Rule"; or (5-8-09)

v. Has no valid water right or other authorization acceptable to the Director for use of the well. (5-8-09)

c. When required by the Director, decommissioning must be done in accordance with the following: (5-8-09)

i**.** Cased wells and boreholes without a continuous seal from the top of the intakes or screen to the surface. The well driller must use one (1) of the following methods as applicable: (5-8-09)

(1) The Director may require that well casing be perforated every five (5) feet from the bottom of the casing to within five (5) feet of the surface. Perforations made must be adequate to allow the free flow of seal material into any voids outside the well casing. There must be at least four equally spaced perforations per section circumference. Approved grout must be pressure pumped to fill any voids outside of the casing. A sufficient volume must be used to completely fill the well and annular space; or (5-8-09)

(2) Fill the borehole with approved seal material as the casing is being removed. (5-8-09)

ii**.** Cased wells and boreholes with full-depth seals. If the well is cased and sealed from the top of the screen or production zone to the land surface, the well must be completely filled with approved seal material. (5-8-09)

iii**.** Uncased wells must be completely filled with approved seal material. (5-8-09)

iv. Dry hole wells or wells from which the quantity of water to meet a beneficial use cannot be obtained must be decommissioned with cement grout, concrete or other approved seal material in accordance with these rules. (5-8-09)

17. Completion of a Well. The Director will consider that every well is completed when the well drilling equipment has been removed, unless written notice has been given to the Director by the well driller that he intends to return and do additional work on the well within a specified period of time. Upon completion of the well, the well must meet all of the required standards. (5-8-09)

a. Upon completion of drilling and prior to removal of well drilling equipment from a water well site, the top of the casing must be completely covered with: (5-8-09)

i. A one-fourth inch (1/4") thick solid, new or like-new steel plate with a three-fourths inch (3/4) threaded and plugged access port, welded to and completely covering the casing (Figure 12, Appendix A); or (5-8-09)

ii. A threaded cap, or a commercially manufactured watertight sanitary well cap (Figure 12, Appendix A); or (5-8-09)

iii. A commercially manufactured water-tight, snorkel-vented or non-vented well cap on any well susceptible to submergence; or (5-8-09)

iv. A control device approved by the Director per Section 42-1603, Idaho Code, on any well that flows at land surface (Figure 11, Appendix A). (5-8-09)

b. Upon the completion of every well, the well driller must permanently affix the stainless steel well tag to the steel surface casing in a manner and location that maintains tag legibility. For closed loop heat exchange wells, the well driller must obtain approval for the well tag placement and method of attachment. The well driller must secure each tag by: (5-8-09)

i. A full-length weld across the top and down each side of the tag; or (5-8-09)

ii. Using one (1) stainless steel, closed-end domed rivet near each of the four (4) corners of the tag. (5-8-09)

iii. Prior to welding or riveting, the tag must be pre-shaped to fit the casing such that both sides to be welded or riveted touch the casing and no gaps exist between the tag and casing. (5-8-09)

18. Pitless Adapters. When a pitless adaptor is used (Figure 12, Appendix A), the adaptor should be of the type approved by the NSF International testing laboratory or the approval code adopted by the Pitless Adaptor Division of the Water Systems Council. The pitless adaptor, including the cap or cover, casing extension, and other attachments, must be so designed and constructed to be water tight and to prevent contamination of the potable water supply from external sources. If a permanent surface or outer casing is installed and is cut off or breached to install the pitless adapter on an inner well casing or liner, the space between the permanent outer casing and the liner or inner casing must be sealed. The well owner or person installing the pitless adaptor must then seal the excavation surrounding the pitless adaptor using an approved seal material. (5-8-09)

19. Pump Installation. No person is allowed to install a pump into any well that would cause a violation of Rule 25, of these rules or other applicable rules or state law. (5-8-09)

20. Explosives. Explosives used in well construction must never be detonated inside the required well casing. Approved explosive casing perforators may be exempted by the Director. (5-8-09)

21. Hydraulic Fracturing. Hydraulic fracturing must be performed only by well drillers licensed in Idaho. The pressure must be transmitted through a drill string and must not be transmitted to the well casing. The driller must provide a report to the Director of the fracturing work which must include well location, fracturing depth, fracturing pressures and other data as requested by the Director. (5-8-09)

22. Drilling Fluids or Drilling Additives. The well driller must use only potable water and drilling fluids or drilling additives that are manufactured for use in water wells, are NSF International, American Petroleum Institute (API), or ASTM/ANSI approved; and do not contain a concentration of any substance in excess of Primary Drinking Water Standards, as set forth in IDAPA 58.01.08, "Rules for Public Drinking Water Systems," according to manufacturer's specifications. The well driller may seek approval from the Director to use specific, non-certified products on a case-by-case basis. In addition, the well driller must ensure the containment of all drilling fluids and materials used or produced to the immediate drilling site, and will not dispose of such fluids or materials into any streams, canals, boreholes, wells, or other subsurface pathways. (5-8-09)

23. Disinfection and Decontamination. Upon completion of a well, the driller is responsible for adding the appropriate amount of disinfecting chemical compound and distributing it throughout the well to achieve a uniform concentration for "in place" disinfection of the well. Chlorine compounds used in accordance with the table listed below will satisfy this requirement. Other methods may be used if approved by the Director in advance.

Amount of Chlorine Needed Per 100 Feet of Water in Well			
Casing Diameter (in.)	Gallons of water in casing per 100 ft. of water depth	Amount of 5.25% Sodium Hypochlorite (Unscented Laundry Bleach)	Amount of 65% Calcium Hypochlorite (Chlorine Granules)
6	147	2 ¼ cups	3 tbsp
8	261	4 cups	5 tbsp
10	408	6 ¼ cups	½ cup
12	588	9 cups	¾ cup
16	1044	1 gal	1 ¼ cup
Note: 1 gal = 4 qt = 8 pt = 16 cups; 1 cup = 16 tbsp			
Chlorine granules or tablets must be dissolved and placed into the well as a solution.			
If another concentration of hypochlorite solution is used, the following equation should be used for calculating amounts. (Volume of water in gallons) X (0.08) / % Hypochlorite (e.g. 50% = 50) = cups of hypochlorite Example: To treat 147 gallons of water using a 50% concentration of hypochlorite solution: (147 gallons water) X (0.08) / 50 = .23 (or approximately 1/4) cup of 50% Hypochlorite solution			

(5-8-09)

24. Sand Production. The maximum sand content produced from a well after initial well development must not exceed fifteen (15) ppm. For the purpose of this rule, sand is considered to be any sediment particle retained on a U.S. standard sieve #200 (seventy-five hundreths (0.075) mm to two (2) mm). (5-8-09)

a. When necessary to mitigate sand production the well driller must: (5-8-09)

i. Construct each well with properly sized casing, screen(s) or perforated intake(s); and (5-8-09)

ii. Install properly sized filter pack(s); or (5-8-09)

iii. Install pre-packed well screens; or (5-8-09)

iv. Employ other methods approved by the Director. (5-8-09)

b. The Director may grant a waiver exempting a well producing water that exceeds the maximum sand content only if the well driller has met the requirements of Rule 25, Subsection 025.24.a. (5-8-09)

c. Sand production in public water system wells. Wells used in connection with a public water system have more stringent requirements. See IDAPA 58.01.08, "Idaho Rules for Public Water Systems." (5-8-09)

25. Well Development and Testing. For each well the well driller must measure and record the static (non-pumping) water level and the pumping water level, and the production rate. The production rate will be determined by a pump, bailer, air-lift, or other industry approved test of sufficient duration to establish production from the well. For wells with no returns the driller must report no returns and the static water level. This information must be documented on the well driller's report. (5-8-09)

026. -- 029. (RESERVED).

030. CONSTRUCTION OF LOW TEMPERATURE GEOTHERMAL RESOURCE WELLS AND BONDING (RULE 30).

01. General. Drillers constructing low temperature geothermal resource wells (bottom hole temperature more than eighty-five (85) degrees Fahrenheit and less than two hundred twelve (212) degrees Fahrenheit) must be qualified under the Well Driller Licensing Rules. All low temperature geothermal resource wells must be constructed in such a manner that the resource will be protected from waste due to lost artesian pressure and temperature. The owner or well driller is required to provide bottom hole temperature data, but the Director may make the final determination of bottom hole temperature, based upon information available to him. (5-8-09)

a. All standards and guidelines for construction and decommissioning (abandonment) of cold water wells apply to low temperature geothermal resource wells except as modified by Rule 30, Subsections 030.03, 030.04, and 030.06. (5-8-09)

b. A drilling prospectus must be submitted to and approved by the Director prior to the construction, modification, deepening or decommissioning (abandonment) of any low temperature geothermal resource well. The well owner and the well driller are responsible for the prospectus and subsequent well construction. (5-8-09)

02. Well Owner Bonding. The owner of any low temperature geothermal resource well must file a surety bond or cash bond as required by Section 42-233, Idaho Code, with the Director in an amount not less than five thousand dollars ($5,000) nor more than twenty thousand dollars ($20,000) payable to the Director prior to constructing, modifying or deepening the well after July 1, 1987. The bond amount will be determined by the Director within the following guidelines. The bond will be kept in force for one (1) year following completion of the well or until released in writing by the Director, whichever occurs first. (5-8-09)

a. Any well less than three-hundred (300) feet deep with a bottom hole temperature of less than one hundred twenty (120) degrees Fahrenheit and a shut-in pressure of less than ten (10) pounds per square inch gage (psig) at land surface must maintain a bond of five thousand dollars ($5,000). (5-8-09)

b. The owner of any well three hundred (300) feet to one thousand (1,000) feet deep with a bottom hole temperature of less than one hundred fifty (150) degrees Fahrenheit and a shut-in pressure of less than fifty (50) psig at land surface must maintain a bond of ten thousand dollars ($10,000). (5-8-09)

c. The owner of any low temperature geothermal resource well not covered by Rule 30, Subsections 030.02.a. and 030.02.b. must maintain a bond of twenty thousand dollars ($20,000). (5-8-09)

d. The Director may decrease or increase the bonds required if it is shown to his satisfaction that well construction or other conditions merit an increase or decrease. (7-1-93)

e. The bond requirements of Section 42-233, Idaho Code, are applicable to wells authorized by water right permits or licenses having a priority date earlier than July 1, 1987, if the well authorized by the permit or license was not constructed prior to July 1, 1987 or if an existing well constructed within the terms of the permit or license is modified, deepened or enlarged on or after July 1, 1987. (7-1-93)

03. Casing. Low temperature geothermal resource wells must be properly cased and sealed to protectfrom cooling by preventing intermingling with cold water aquifers. (5-8-09)

a. Steel casing which meets or exceeds the minimum specifications for permanent steel casing of Rule 25, Subsection 025.04 must be installed in every well. The Director may require a more rigid standard for collapse and burst strength as depths or pressures may dictate. Every low temperature geothermal resource well which flows at land surface must have a minimum of forty (40) feet of conductor pipe set and cemented its entire length. (5-8-09)

b. Casing must be installed from twelve (12) inches above land surface into the overlying confining strata of the thermal aquifer. The casing schedule may consist of several different casing strings (i.e. conductor pipe, surface casing, intermediate casing, production casing) which may all extend to land surface or may be overlapped and sealed or packed to prevent fluid migration out of the casing at any depth (Figure 13, Appendix A). (5-8-09)

i. Low temperature geothermal resource wells less than one thousand (1,000) feet deep and which encounter a shut-in pressure of less than fifty (50) psig at land surface must have two (2) strings of casing set and cemented to land surface. Conductor pipe must be a minimum of forty (40) feet in length or ten percent (10%) of the total depth of the well whichever is greater. Surface casing must extend into the confining stratum overlying the aquifer. (5-8-09)

ii. Low temperature geothermal resource wells one thousand (1,000) feet or more in depth or which will likely encounter a shut-in pressure of fifty (50) psig or more at land surface require prior approval of the drilling plan by the Director and must have three strings of casing cemented their total length to land surface. Conductor pipe must be a minimum length of forty (40) feet. Surface casing must be a minimum of two hundred (200) feet in length or ten percent (10%) of the total depth of the well, whichever is greater. Intermediate casing must extend into the confining stratum overlying the aquifer. (5-8-09)

c. Subsection 030.03.b. may be waived if it can be demonstrated to the Director through the lithology, electrical logs, geophysical logs, injectivity tests or other data that formations encountered below the last casing string set, will neither accept nor yield fluids at anticipated pressure to the borehole. (5-8-09)

d. A nominal borehole size of two (2) inches in diameter larger than the Outside Diameter (O.D.) of the casing or casing coupler (whichever is larger) must be drilled. All casing designations must be by O.D. and wall thickness and must be shown to meet a given specification of the American Petroleum Institute, the American Society for Testing and Materials, the American Water Works Association or the American National Standards Institute. The last string of casing set during drilling operations must, at the Director's option, be flanged and capable of mounting a valve or blow out prevention equipment to control flows at the surface before drilling resumes. (5-8-09)

04. Sealing of Casing. All casing must be sealed its entire length with cement or a cement grout mixture unless waived by the Director. The seal material must be placed from the bottom of the casing to land surface either through the casing or tubing or by use of a tremie pipe. The cement or cement grout must be undisturbed for a minimum of twenty-four (24) hours or as needed to allow adequate curing. (5-8-09)

a. A caliper log may be run for determining the volume of cement to be placed with an additional twenty-five (25%) percent on site ready for mixing. If a caliper log is not run, an additional one hundred (100%) percent of the calculated volume of cement must be on site ready for placement. (5-8-09)

b. If there is no return of cement or cement grout at the surface after circulating all of the cement mixture on site, the Director will determine whether remedial work should be done to insure no migration of fluids around the well bore. (5-8-09)

c. The use of additives such as bentonite, accelerators, retarders, and lost circulation material must follow manufacturer's specifications. (5-8-09)

05. Blow Out Prevention Equipment. The Director may require the installation of gate valves or annular blow out prevention equipment to prevent the uncontrolled blow out of drilling mud and geothermal fluid. (7-1-93)

06. Repair of Wells. The well driller must submit a drilling prospectus to the Director for review and approval prior to the repair or modification of a low temperature geothermal resource well. (5-8-09)

07. Decommissioning (Abandoning) of Wells. Proper decommissioning (abandonment) of any low temperature geothermal resource well requires the following: (5-8-09)

a. All cement plugs must be pumped into the hole through drill pipe or tubing. (5-8-09)

b. All open annuli must be completely filled with cement. (5-8-09)

c. A cement plug at least one hundred (100) feet in vertical depth must be placed straddling (fifty (50) feet above and fifty (50) feet below) the zone where the casing or well bore meets the upper boundary of each ground water aquifer. (5-8-09)

d. A minimum of one hundred (100) feet of cement must be placed straddling each drive shoe or guide shoe on all casing including the bottom of the conductor pipe. (5-8-09)

e. A surface plug of either cement grout or concrete must be placed from at least fifty (50) feet below the top of the casing to the top of the casing. (5-8-09)

f. A cement plug must extend at least fifty (50) feet above and fifty (50) feet below the top of any liner installed in the well. The Director may waive this rule upon a showing of good cause. (5-8-09)

g. Other decommissioning (abandonment) procedures may be approved by the Director if the owner or operator can demonstrate that the low temperature geothermal resource, ground waters, and other natural resources will be protected. (5-8-09)

h. Approval for decommissioning (abandonment) of any low temperature geothermal well must be in writing by the Director prior to the beginning of any decommissioning (abandonment) procedures. (5-8-09)

031. -- 034. (RESERVED).

035. HEALTH STANDARDS (RULE 35).

01. Public Water System Wells. In addition to meeting these standards, all wells that are constructed for public supply of domestic water must meet all of the requirements set forth by the Idaho Department of Environmental Quality Rules, IDAPA 58.01.08, "Idaho Rules for Public Drinking Water Systems." (5-8-09)

02. Special Standards for Construction of Wells When Mineralized or Contaminated Water Is Encountered. Any time in the construction of a well that mineralized or contaminated water is encountered, the well driller must take the appropriate steps necessary to prevent the poor quality waters from entering the well or moving up or down the annular space around the well casing. The method employed to case and seal out this water will be determined by the well driller, provided all other minimum standards are met. The well driller will take special precautions in the case of filter-packed wells to prevent water of inferior quality from moving vertically in the filter packed portions of the well. All actions taken will be clearly documented on the well driller's report. (5-8-09)

03. Distances From Contaminant Sources. All water wells constructed for domestic use must comply with minimum distances from septic tanks, drain fields, drainfield replacement area and other siting requirements as set forth in Rule 25, Subsection 025.01.d. (5-8-09)

036. OWNERS RESPONSIBILITIES FOR WELL USE AND MAINTENANCE (RULE 36).
After a well is completed the well owner is responsible for water quality testing, properly maintaining the well, and reporting problems with a well to the Director. All wells must be capped, covered and sealed such that debris cannot enter the well, persons or animals cannot fall into the well, and water cannot enter the well around the outside of the casing. Pursuant to Section 42-1603, Idaho Code, the owner of any artesian well that will flow at land surface is required to apply to the Director for approval of a flow control device. (5-8-09)

01. Use. The well owner must not operate any well in a manner that causes waste or contamination of the ground water resource. Failure to operate, maintain, knowingly allow the construction of any well in a manner that violates these rules, or failure to repair or properly decommission (abandon) any well as herein required will subject the well owner to civil penalties as provided by statute. (5-8-09)

02. Maintenance. The well owner must: (5-8-09)

a. Not allow modification to wells under their control without first obtaining an approved Idaho Department of Water Resources (IDWR) permit, pursuant to Section 42-235, Idaho Code; (5-8-09)

b. Maintain the minimum casing height of twelve (12) inches above land surface and finished grade; (5-8-09)

c. Maintain the appropriate well cap, and control device if required, according to these Rules; and (5-8-09)

d. Not install or allow the installation of any well pump that would cause a violation of the sand production requirements in accordance with these Rules or allow the well to pump in excess of that allowed by a valid water right or domestic exemption. (5-8-09)

e. Maintain the well to prevent waste or contamination of ground waters through leaky casings, pipes, fittings, valves, pumps, seals or through leakage around the outside of the casings, whether the leakage is above or below the land surface. Any person owning or controlling a non-compliant well must have the well repaired by a licensed well driller under a permit issued by the Director in accordance with these Rules. (5-8-09)

03. New Construction. The well owner must not construct or allow construction of any permanent building, except for buildings to house a well or plumbing apparatus, or both, closer than ten (10) feet from an existing well. (5-8-09)

04. Maintain All Other Separation Distances. The well owner must not construct or install, or allow the construction or installation of any object listed in a location closer than that allowed by the table of Rule 25, Subsection 025.01.d. (5-8-09)

05. Unusable Wells. The well owner must have any unusable well repaired or decommissioned (abandoned) by a licensed well driller under a permit issued by the Director in accordance with these Rules.
S (5-8-09)

06. Wells Posing a Threat to Human Health and Safety or Causing Contamination of the Ground Water Resource. The well owner must have any well shown to pose a threat to human health and safety or cause contamination of the ground water resource immediately repaired or decommissioned (abandoned) by a licensed well driller under a permit issued by the Director in accordance with these Rules. (5-8-09)

037. -- 039. (RESERVED).

040. AREAS OF DRILLING CONCERN (RULE 40).

01. General. (7-1-93)

a. The Director may designate an “area of drilling concern” to protect public health, or to prevent waste and contamination of ground or surface water, or both, because of factors such as aquifer pressure, vertical depth to the aquifer, warm or hot ground water, or contaminated ground or surface waters. (7-1-93)

b. The designation of an area of drilling concern does not supersede or preclude designation of part or all of an area as a Critical Ground Water Area (Section 42-233a, Idaho Code), Ground Water Management Area (Section 42-233b, Idaho Code), or Geothermal Resource Area (Sections 42-4002 and 42-4003, Idaho Code). (7-1-93)

c. The designation of an area of drilling concern can include certain aquifers or portions thereof while excluding others. The area of drilling concern may include low temperature geothermal resources while not including the shallower cold ground water systems. (7-1-93)

02. Bond Requirement. (7-1-93)

a. The minimum bond to be filed by the well driller with the Director for the construction or modification of any well in an area of drilling concern is ten thousand dollars ($10,000) unless it can be shown to the satisfaction of the Director that a smaller bond is sufficient. (5-8-09)

b. The Director may determine on a case-by-case basis if a larger bond is required based on the estimated cost to repair, complete or properly decommission (abandon) a well. (5-8-09)

03. Additional Requirements. (7-1-93)

a. A driller must demonstrate to the satisfaction of the Director that he has the experience and knowledge to adequately construct or decommission (abandon) a well which encounters warm water or pressurized aquifers. (5-8-09)

b. A driller must demonstrate to the satisfaction of the Director that he has, or has immediate access to, specialized equipment or resources needed to adequately construct or decommission (abandon) a well. (5-8-09)

041. -- 044. (RESERVED).

045. DRILLING PERMIT REQUIREMENTS (RULE 45).

01. General Provisions. (7-1-93)

a. Drilling permits are required pursuant to Section 42-235, Idaho Code, prior to construction or modification of any well. (5-8-09)

b. Drilling permits will not be issued for construction of a well which requires another separate approval from the department, such as a water right permit, transfer, amendment or injection well permit, until the other separate permitting requirements have been satisfied. (5-8-09)

c. The Director may allow the use of a start card permit or give verbal approval to a well driller for the construction of cold water single family domestic wells. Start cards must be received by the Department at least two office hours prior to commencing construction of the well. (5-8-09)

d. The Director may give verbal approval to a well driller for the construction of a well for which other permitting requirements have been met, provided that the driller or owner has filed the drilling permit application and appropriate fee. (5-8-09)

e. The Director will not give a verbal approval or allow the use of a start card permit for wells constructed in a designated Area of Drilling Concern, Critical Ground Water Area, or Ground Water Management Area. (5-8-09)

f. A well driller will not construct, drill or modify any well until a drilling permit has been issued, or verbal approval granted. (5-8-09)

02. Effect of a Permit. (7-1-93)

a. A drilling permit authorizes the construction or modification of a well in compliance with these rules and the conditions of approval on the permit. (5-8-09)

b. A drilling permit does not constitute a water right, injection well permit or other authorization which may be required, authorizing use of water from a well or discharge of fluids into a well. (5-8-09)

c. A drilling permit may not be assigned from one owner to another or from one driller to another. (5-8-09)

d. A drilling permit authorizes the construction of one (1) well, except for blanket monitoring well and blanket remediation well drilling permits. (5-8-09)

03. Exclusions.For the purposes of these Rules, artificial openings and excavations that do not constitute a well and are not subject to the drilling permit requirements must be modified, constructed, or decommissioned (abandoned) in accordance with minimum well construction standards. The Director may require decommissioning (abandonment) of artificial openings and excavations constructed pursuant to Rule 45, Subsection 045.03 of these rules, when the use ceases or if the holes may contribute to waste or contamination of the ground water. The following types of artificial openings and excavations are not considered wells: (5-8-09)

a. Artificial openings and excavations with total depth less than eighteen (18) feet. (5-8-09)

b. Artificial openings and excavations for collecting soil or rock samples, determining geologic properties, or mineral exploration or extraction, including gravel pits. (5-8-09)

c. Artificial openings and excavations for oil and gas exploration for which a permit has been issued pursuant to Section 47-320, Idaho Code. (5-8-09)

d. Artificial openings and excavations constructed for de-watering building or dam foundation excavations. (5-8-09)

04. Converting an Artificial Openings or Excavations Not Constructed as a Well for Use as a Well. Artificial openings and excavations that were not constructed as a well pursuant to a drilling permit, if subsequently converted to obtain water, monitor water quantity or quality, or to dispose of water or other fluids, must be reconstructed by a licensed driller in compliance with well construction standards and drilling permit requirements. (5-8-09)

05. Fees. (7-1-93)

a. Drilling permit fees are as prescribed by Section 42-235, Idaho Code. (5-8-09)

b. The difference between the drilling permit fee required by Section 42-235 Idaho Code as applicable, must be paid when an existing well constructed on or after July 1, 1987, for which the lower drilling permit fee was paid, is authorized by the Director for a use which would require the larger drilling permit fee. (5-8-09)

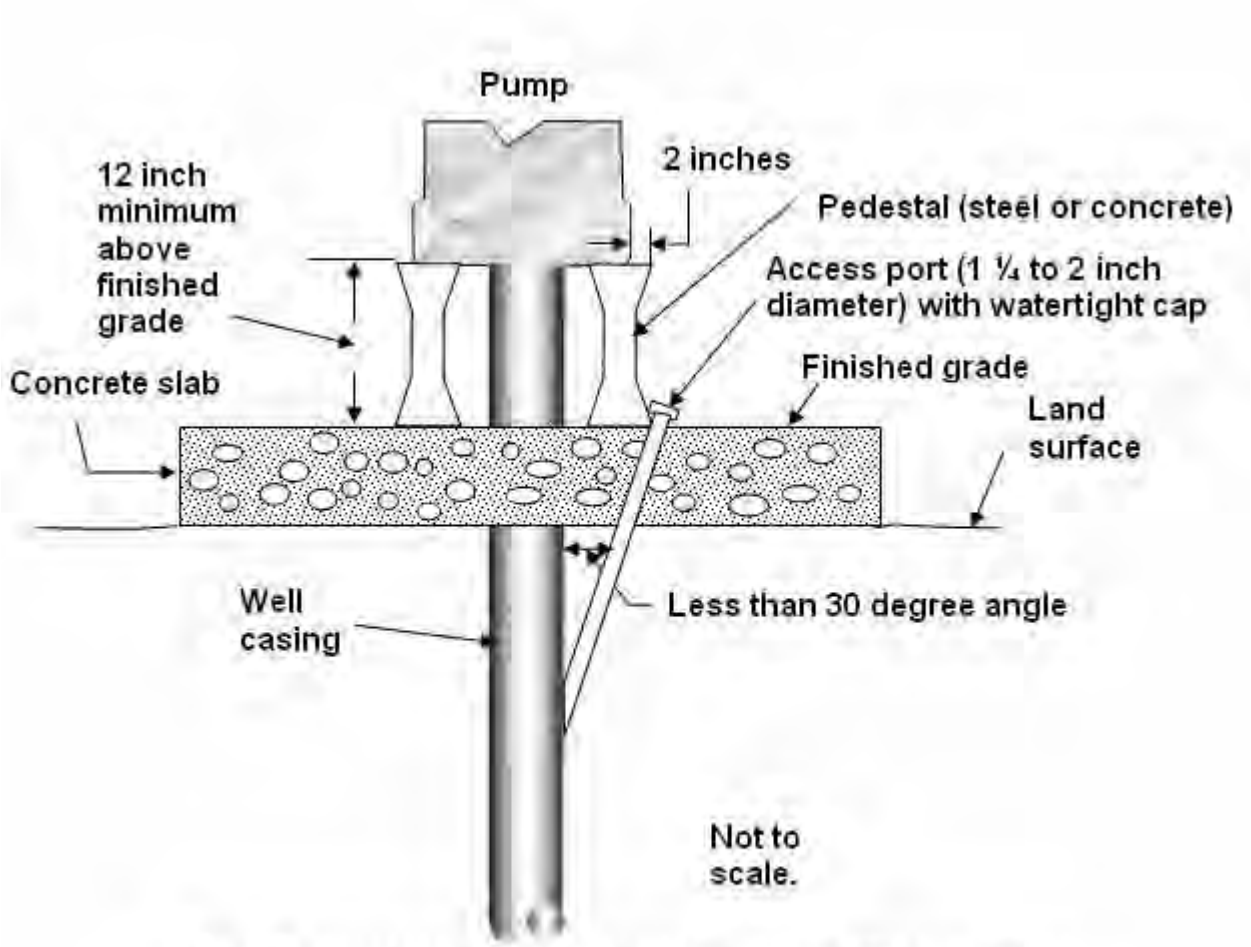
046. -- 049. (RESERVED).

050. PENALTIES (RULE 50).
A person owning or controlling a well that allows waste or contamination of the state's ground water resources or causes a well not to meet the construction standards provided in these Rules is subject to the civil penalties as provided by statute. A driller who violates the foregoing provisions of these well construction standards Rules is subject to enforcement action and the penalties as provided by Statute. (5-8-09)

051. -- 999. (RESERVED).

APPENDIX A

Figure 01. Concrete Slabs and Finished Grade



Note. Pedestal shall not extend more than two (2) inches past pump base in horizontal direction.

Figure 02. Annular Space and Overbore

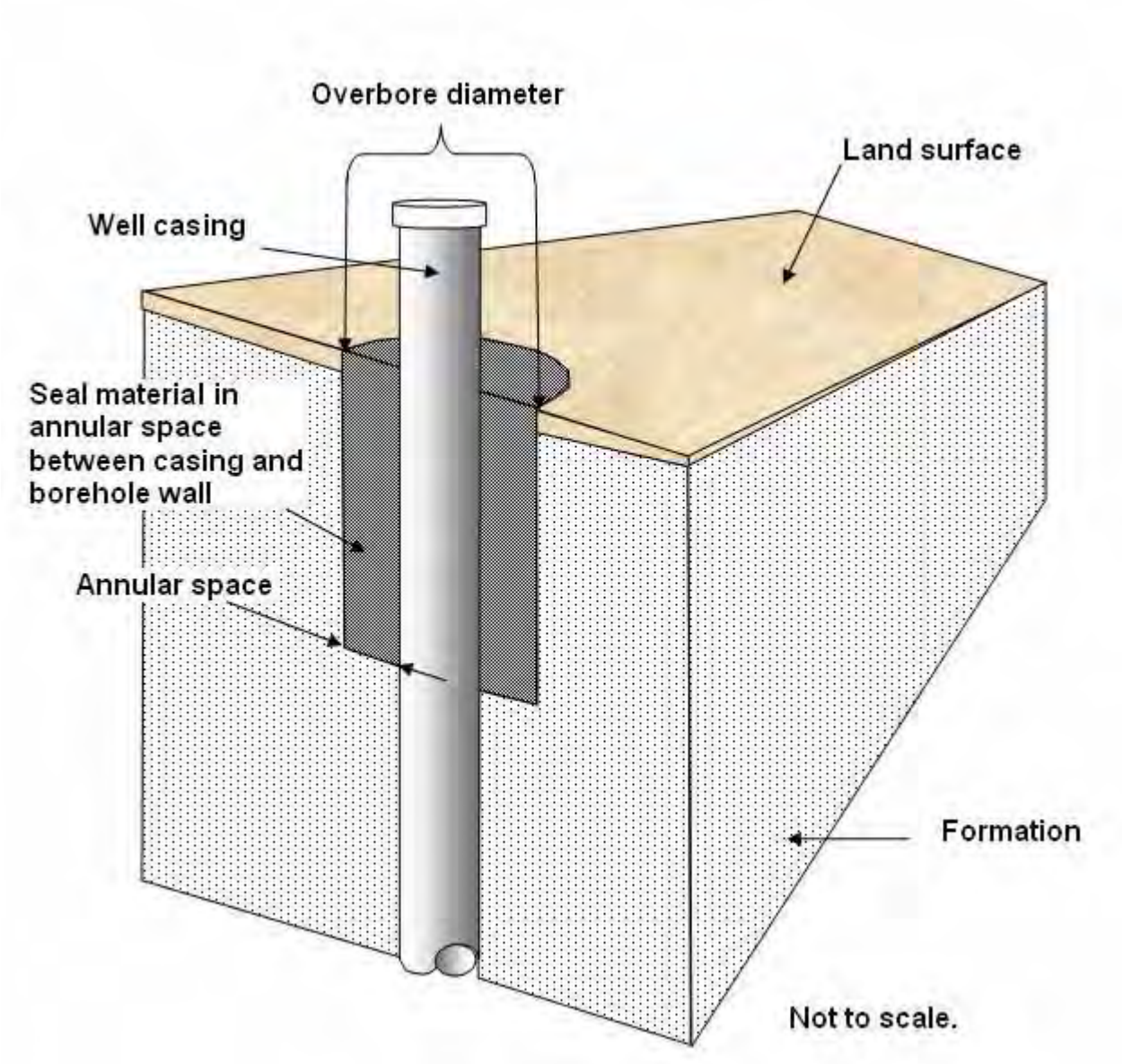


Figure 03. Overbore Requirements When a Tremie Pipe is Left in Place and A Grout Seal Installed

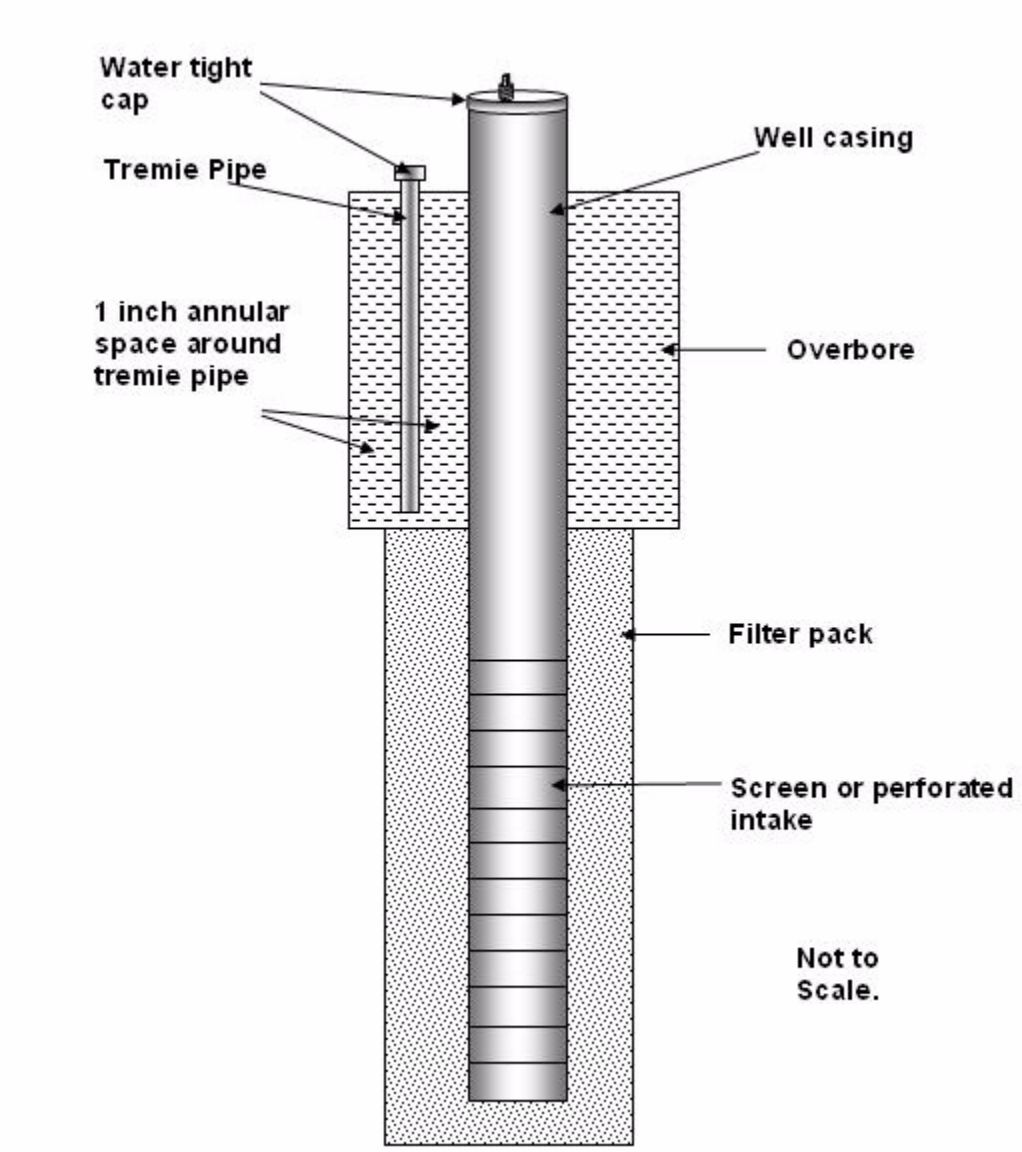


Figure 04. Sealing Requirements in Consolidated Formations

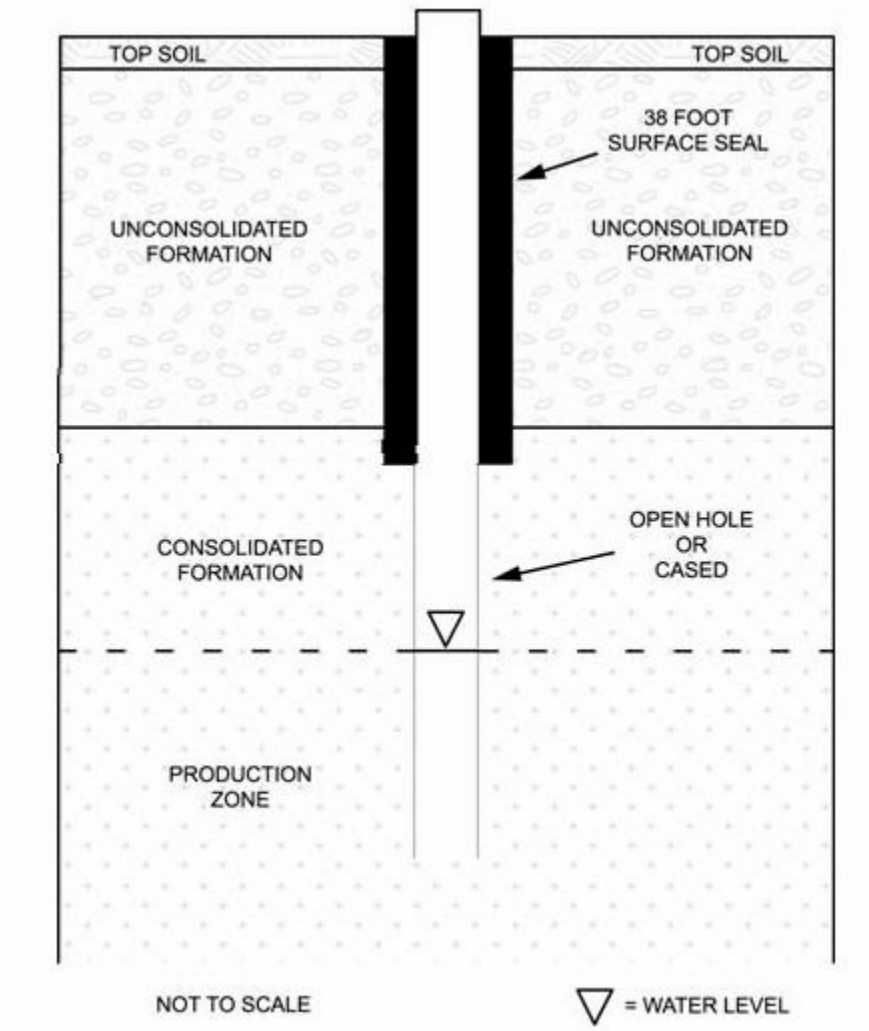


Figure 05. Sealing Requirements in Unconsolidated Formation without Confining Layers

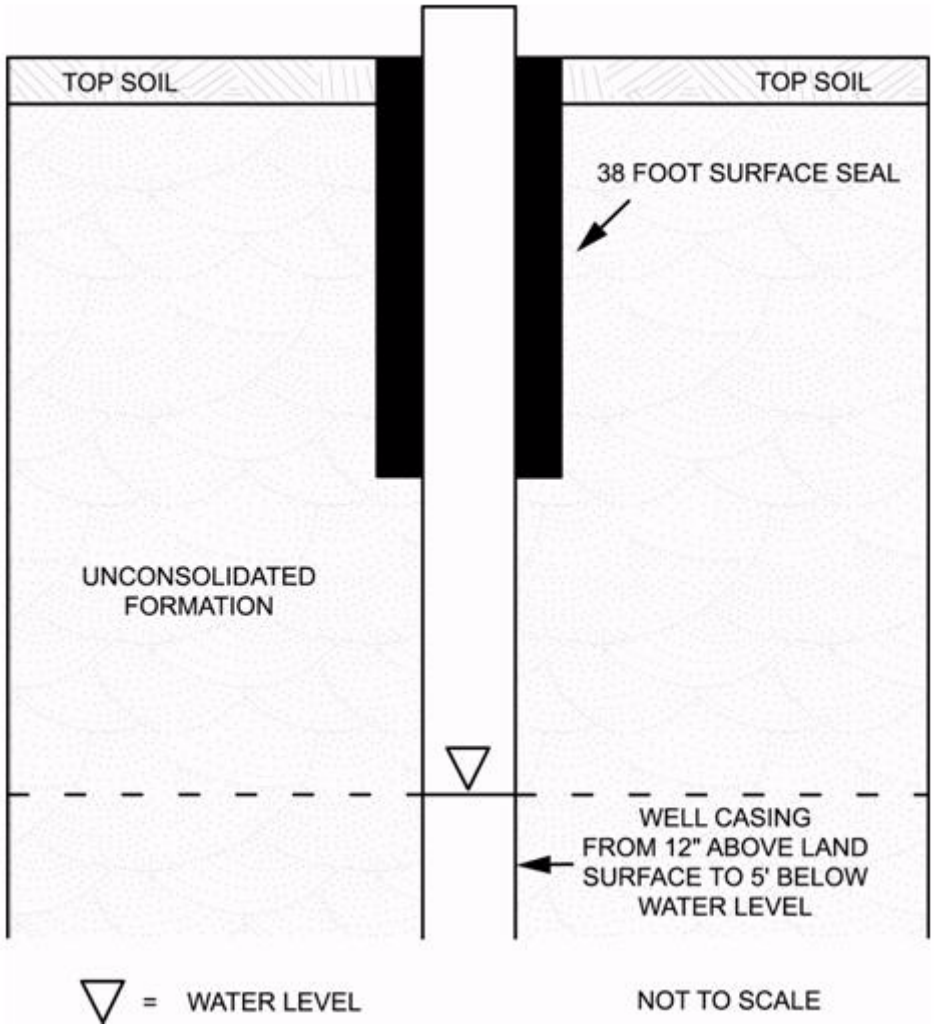


Figure 06. Rathdrum Prairie Boundary

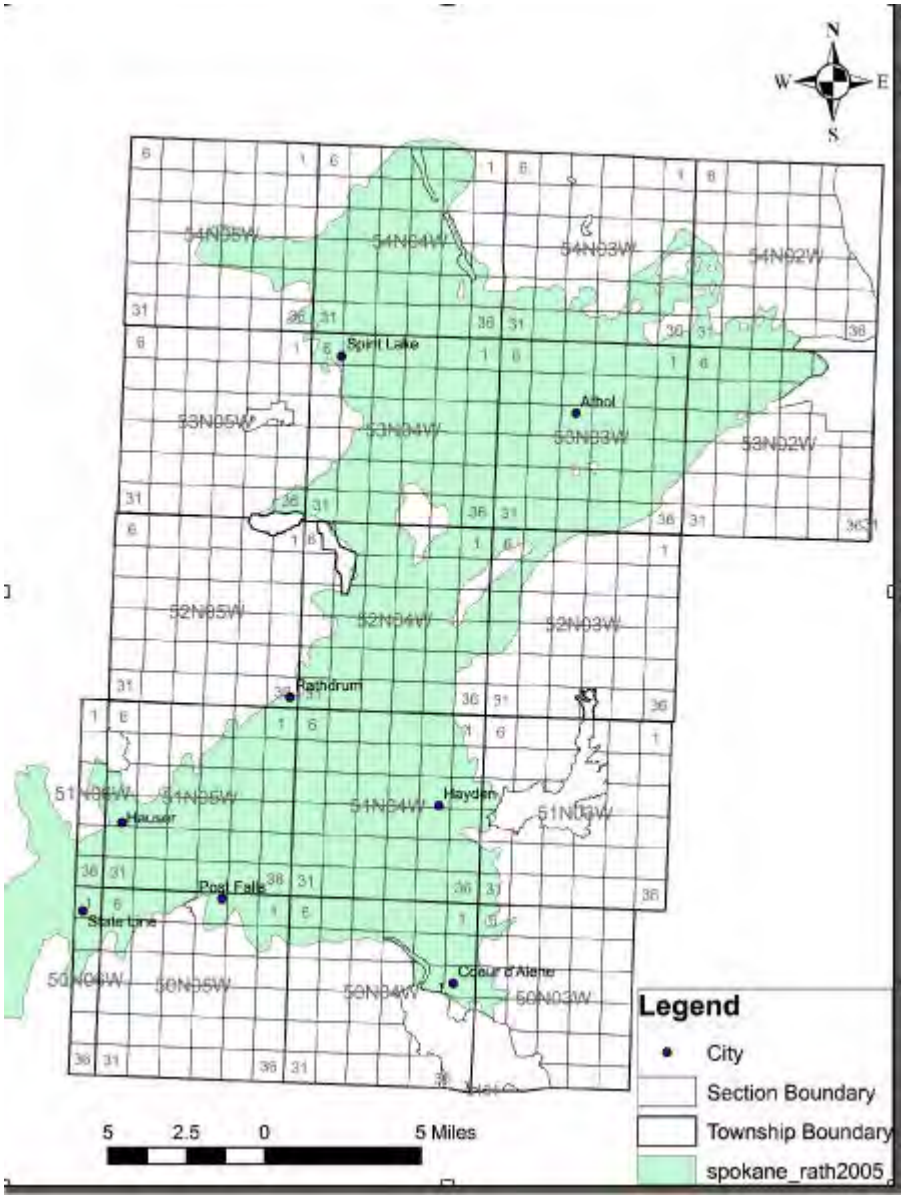


Figure 07. Sealing Requirements in the Rathdrum Prairie

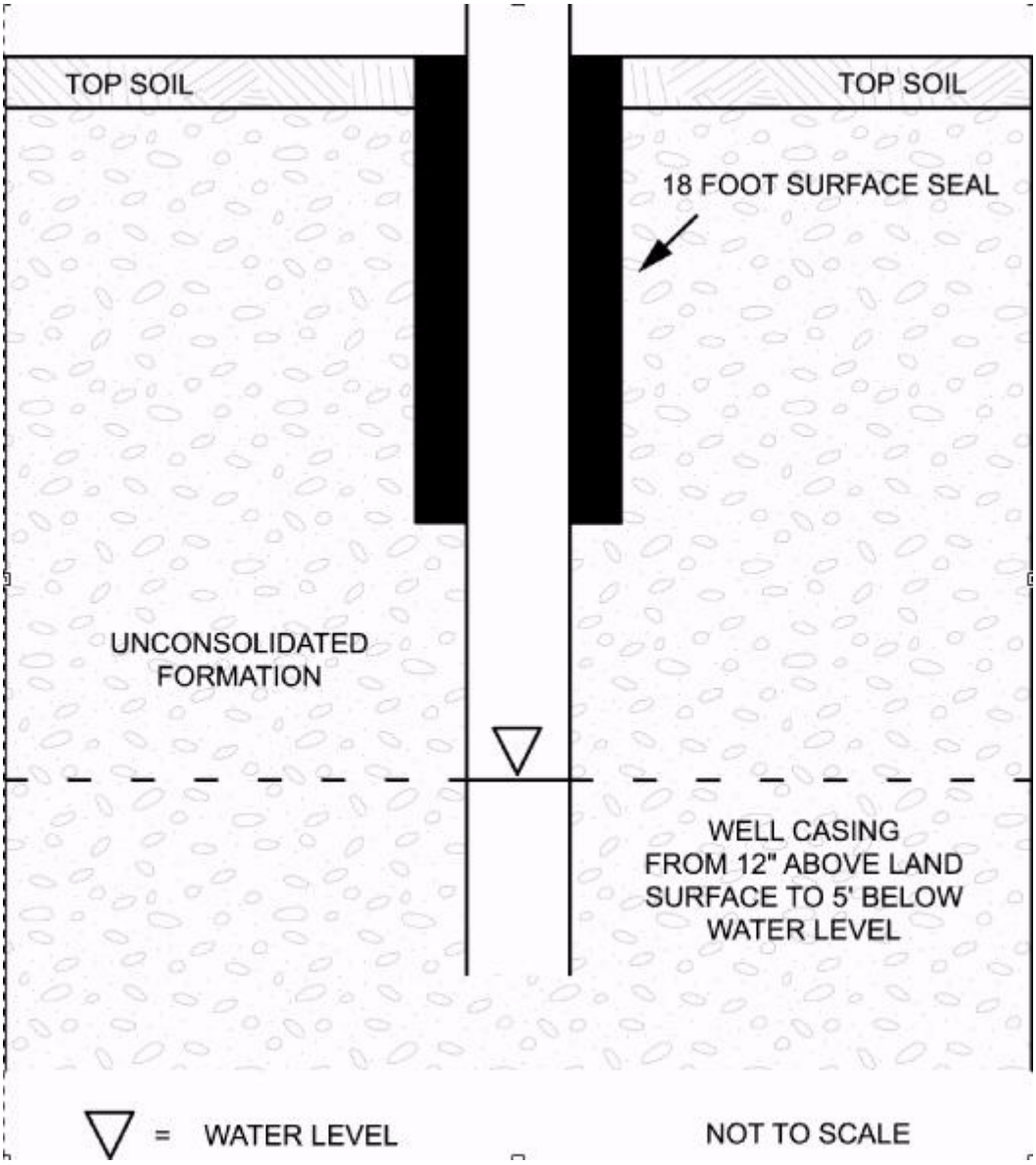


Figure 08. Sealing Requirements in Unconsolidated Formations with Confining Layers

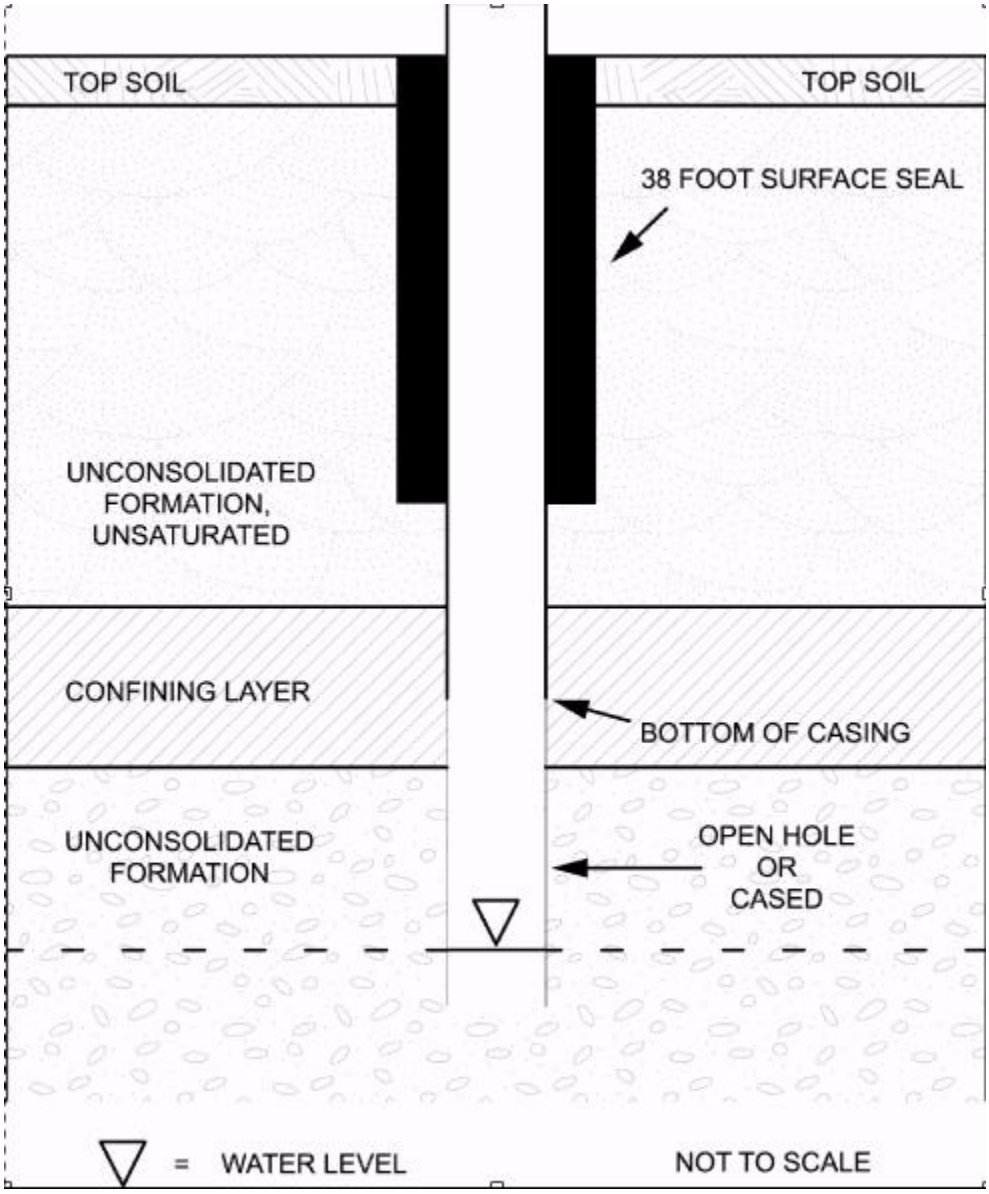


Figure 09. Sealing Requirements for Artesian Wells in Unconsolidated Formations

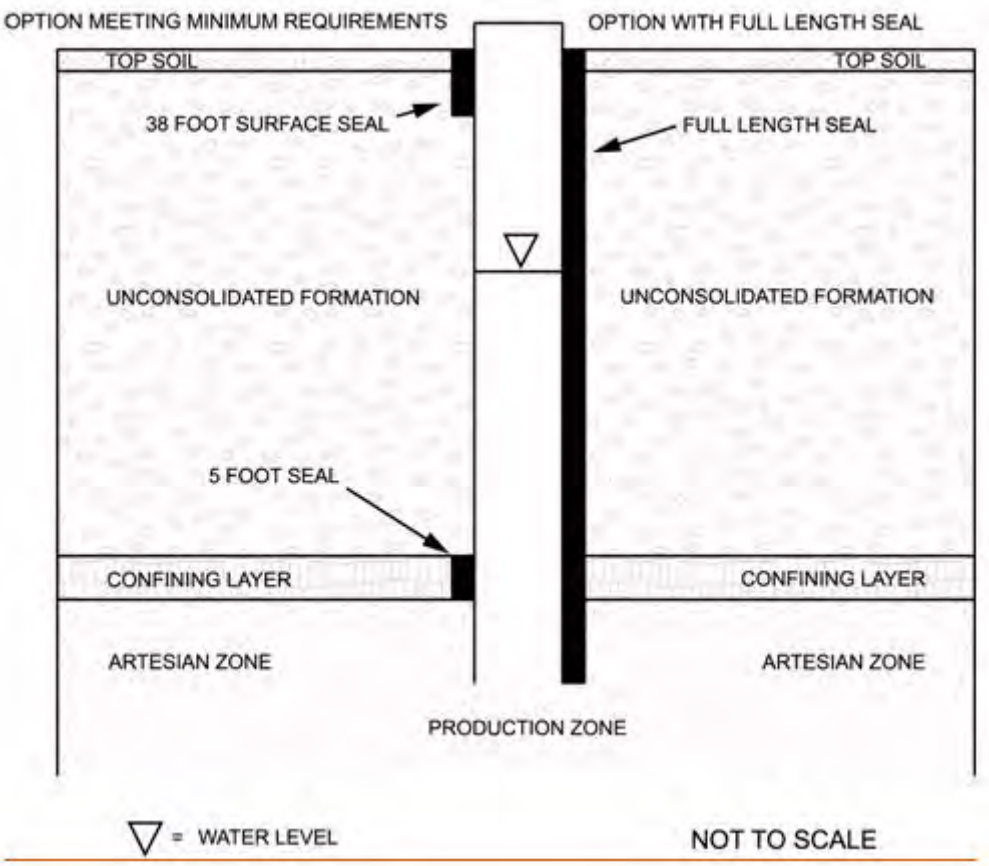


Figure 10. Sealing Requirements for Artesian Wells in Consolidated Formations

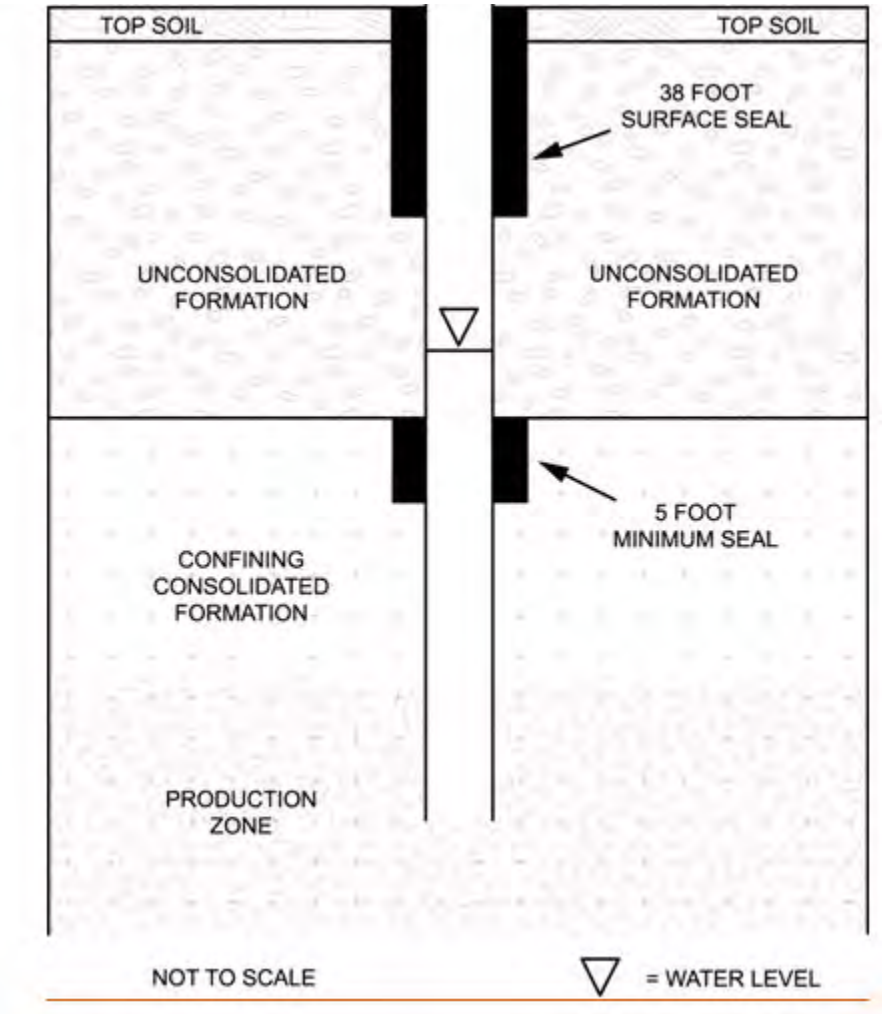
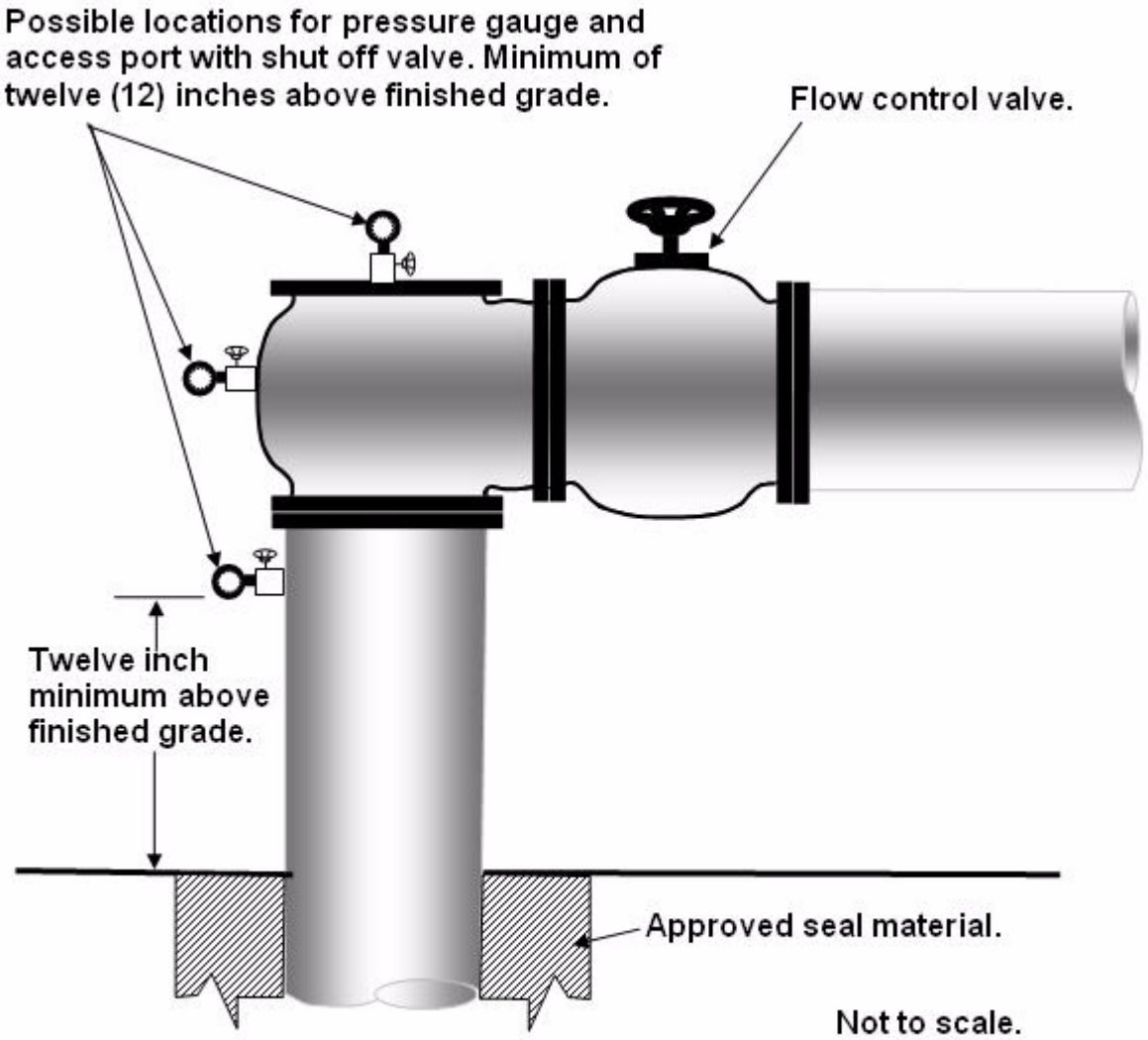


Figure 11. Access Ports, Pressure Gauges, and Control Valves



Note. Application and approval of control device is required on any flowing artesian well per Section 42-1603, Idaho Code.

Figure 12. Well Cap and Access Port

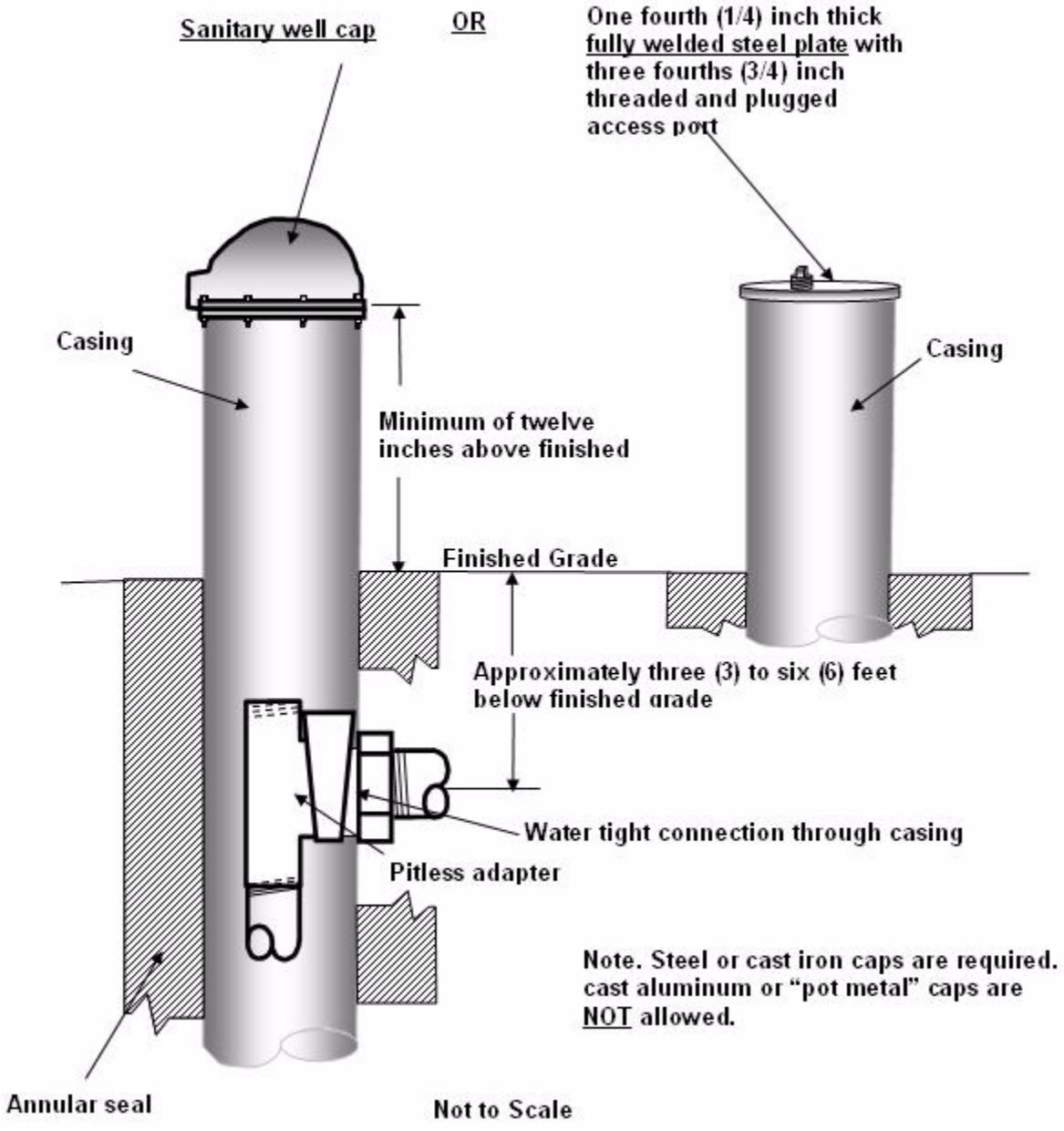
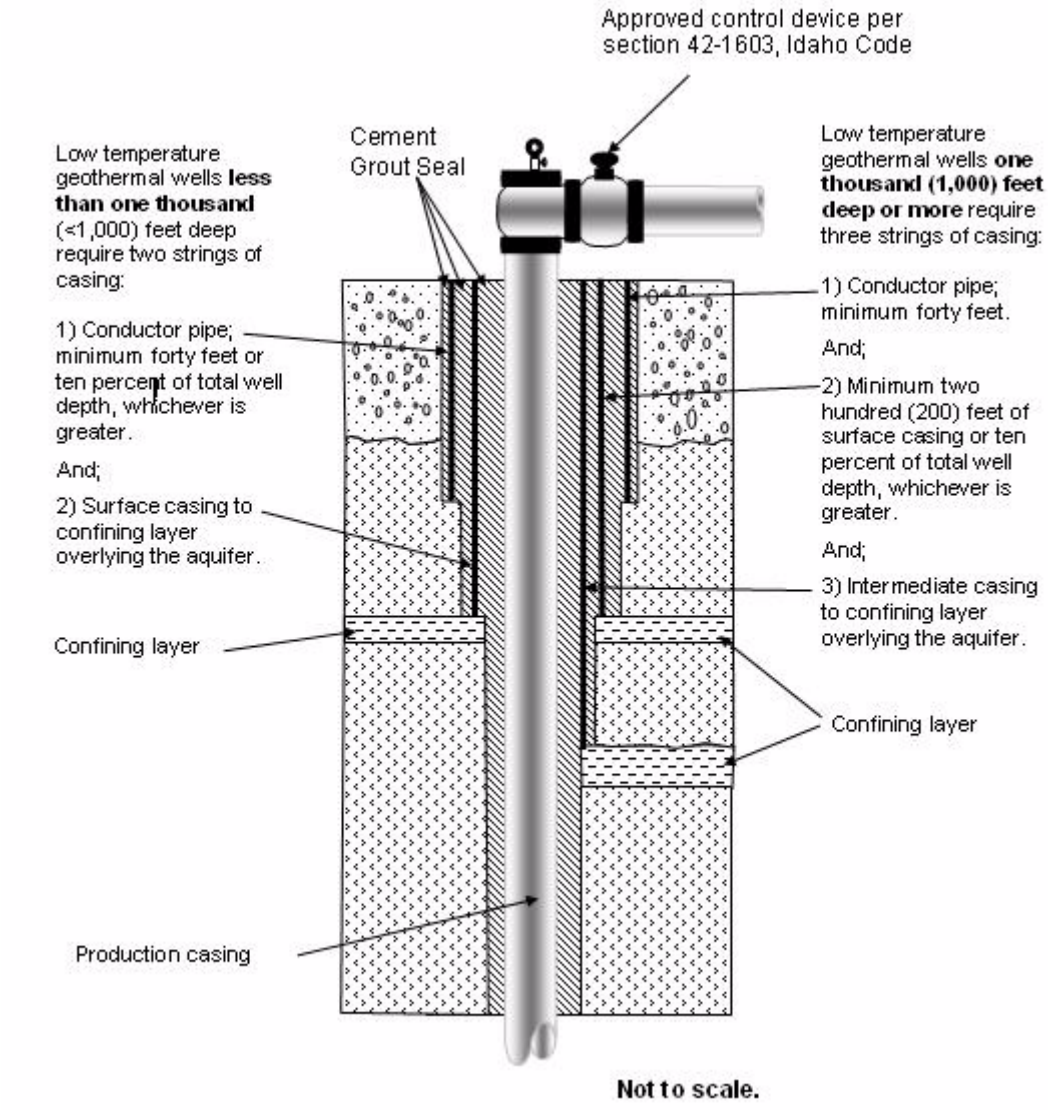


Figure 13. Casing Requirements for Low Temperature Geothermal Wells



Subject Index

W

APPENDIX B
TECHNICAL PROCEDURES

TECHNICAL GUIDELINE FOR CHAIN OF CUSTODY

TG-1.2-23

Rev. #2

8/20/2009

Table of Contents

List of Exhibits

List of Figures

TG-1.2-23 Chain of Custody

1.0 PURPOSE

This technical guideline establishes the requirements for documenting and maintaining environmental sample chain of custody from point of origin to receipt of the sample at the analytical laboratory.

2.0 APPLICABILITY

When specifically invoked by project work plans, sampling plans, or QA plans, this technical guideline shall apply to all types of air, soil, water, sediment, biological, and/or core samples to be analytically tested in support of environmental investigations by Golder Associates Inc., and is applicable from the time of sample acquisition until custody of the sample is transferred to an analytical laboratory.

3.0 DEFINITIONS

3.1. Custody

Custody refers to the physical responsibility for sample integrity, handling, and/or transportation. Custody responsibilities are effectively met if the samples are:

- in the responsible individual's physical possession;
- in the responsible individual's visual range after having taken possession;
- secured by the responsible individual so that no tampering can occur; or
- secured or locked by the responsible individual in an area in which access is restricted to authorized personnel.

3.2. Chain of Custody

Chain of custody refers to the history of the physical transfer of samples between the sampler, the transporter, or carrier, and the laboratory technician. Chain of custody documentation is required as evidence that the integrity of samples was maintained during transfer.

4.0 DISCUSSION

Environmental samples must be tracked, handled and transported in a manner such that sample integrity and identification (to the location and interval at which they were obtained) is maintained. The sample custodian must maintain proper storage and custody of samples from the time of collection until transport to the laboratory. The sampler shall initiate Chain of Custody forms which accompany samples from the collection site to the laboratory and provide documentation of any transfer of custody throughout transport. Sample identification and integrity shall be ensured by the application of seals and labels to the sample containers at the time of sample collection. Seals and labels shall be verified upon receipt of samples at the analytical laboratory; unacceptable samples shall be identified on the Chain of Custody form, and referred to the Geologist/Field Engineer or Project Manager for evaluation and appropriate disposition.

5.0 RESPONSIBILITIES

5.1. Project Manager

The Project Manager is responsible for the overall management of environmental sampling activities, for designating the sample shipment method (considering permitted sample holding times), for delegating

sampling responsibilities to qualified personnel, and reviewing any Field Change Requests that may be initiated during the investigation.

5.2. Geologist/Field Engineer

The Geologist/Field Engineer is responsible for: 1) providing general supervision of sampling operations as directed by the Project Manager; 2) ensuring proper temporary storage of samples and proper transportation of samples from the sampling site to the laboratory; and 3) initiating Field Change Requests when required. The Geologist/Field Engineer is also responsible for tracking Chain of Custody forms for samples to ensure timely receipt of the completed original, for reviewing Chain of Custody forms to ensure appropriate documentation of sample transfers, and for advising the Project Manager of any problems observed that are related to sample integrity and chain of custody. The Geologist/Field Engineer may delegate document tracking and review responsibilities to suitably qualified personnel.

5.3. Sampler

The sampler may be the same individual as the Geologist/Field Engineer and is responsible for: 1) sample acquisition in compliance with applicable guidelines and procedures; 2) checking sample integrity and documentation prior to transfer; 3) initiating the Chain of Custody form; 4) maintaining custody of the samples while completing the sampling project; and 5) physically transferring the samples to the transporter or directly to the laboratory.

5.4. Laboratory Sample Custodian

The laboratory sample custodian or designated sample receiving technician is responsible for: 1) inspecting transferred samples to ensure that seals are intact, that labels are affixed, that sample condition is acceptable, and that Sample Integrity Data Sheets are completed, when required for a particular project; 2) completing the Chain of Custody form upon receipt; 3)forwarding copies of the completed Chain of Custody form to the Project Manager; and 4) segregating and identifying unacceptable samples, and subsequently notifying the Golder Project Manager.

5.5. Document Custodian

The document custodian (project manager or administrative assistant) is responsible for maintaining completed Chain of Custody forms in the project files.

6.0 EQUIPMENT AND MATERIALS

- Seals and labels (Exhibit A)
- Sample Integrity Data Sheets (Exhibit B), if required by the applicable sampling procedure, work plan, sampling plan, or quality assurance (QA) plan, or if requested by the Project Manager
- Chain of Custody forms (Exhibit C)
- Field Change Request form (Exhibit D)
- Packing and shipping materials, which may include coolers or insulated packing boxes, ice, "blue ice" or dry ice, cardboard packing boxes, wooden core storage boxes, and shipping labels. If dry ice is used, caution should be used so that samples do not freeze resulting in broken jars and negative impact to other samples in the same carrier.

7.0 GUIDELINE

7.1. Seals, Labels, and Initial Storage

At the time of collection, all samples shall be sealed, labeled, and appropriately stored in the custody of the sample custodian as defined in 3.1 above. Examples of standard seals and labels are included in Exhibit A.

7.2. Sample Packaging

All samples shall be packaged appropriately for shipping to protect them from damage, to ensure that moisture content is maintained where necessary, and to ensure that appropriate temperatures are maintained as required. All sample shipping containers shall be sealed (see Exhibit A) to prevent tampering.

Environmental core sample boxing, marking, and labeling shall be in compliance with TG-1.2-2, "Geotechnical Rock Core Logging." Other types of environmental samples stored in jars or bottles may be packaged in insulated coolers, or, if sample temperature is not a concern, in the original sample container packing boxes. Where cooling is required, samples shall be shipped in insulated coolers containing bagged or pre-packaged ice sufficient to keep the samples at 4°C ± 2°. All samples should be carefully placed in the appropriate container(s) and packaged with paper or bubble-wrap to prevent significant movement or breakage during transport.

Samples from boreholes shall be packaged, where appropriate, by placing the jars in shipping containers from the top right corner downward, and from left to right, beginning with the first sample taken as shown in Figure 8-1. An alternative packaging order may be appropriate to isolate contaminated samples to minimize the risk for cross-contamination.

A label containing the following information should be affixed to the front of each shipping container containing environmental samples:

- Project Number
- Location
- Borehole number(s) (if appropriate)
- Date collected
- Sample numbers enclosed

Boxes should be numbered consecutively; the last box from a borehole or drillhole shall also be identified "EOH," (i.e., end of hole).

7.3. Sample Examination

Prior to transfer of samples, the sampler shall ensure that:

- labels and seals are affixed and completely filled out;
- Chain of Custody documentation corresponds to the samples in the shipment;
- special handling and storage requirements are identified where required;
- Sample Integrity Data Sheets are available where required by applicable sampling guidelines or the Project Manager;

- there are no indications of sample container leaks or other questionable conditions that may affect the integrity of the sample; and
- hazardous and/or radioactive samples are clearly identified as such.

Samples that do not meet the requirements for initial transfer shall be referred to the Geologist/Field Engineer or Project Manager for disposition.

7.4. Chain of Custody Form Initiation

The sampler shall initiate the Chain of Custody form (Exhibit C) for the initial transfer of samples. Chain of Custody forms supplied by the analytical laboratory may be used in lieu of the form shown in Exhibit C. At a minimum, the following information shall be entered on the form:

- the destination of the samples and the transporter or carrier;
- the project identification and sampling site;
- the date and time of sample collection;
- the sample identification numbers and descriptions (e.g., media, container);
- analysis required for samples included in the shipment; and
- QA and reporting instructions for the laboratory.

When all required information has been entered the sampler shall sign and date the Chain of Custody form as the initiator.

7.5. Transfer of Custody

To document the initial transfer of samples, the sampler relinquishing custody and the transporter accepting custody shall sign, date, and note the time of transfer on the Chain of Custody form. If the transporter is not an employee of Golder Associates Inc., the sampler may identify the carrier and reference the bill of lading number in lieu of the transporter's signature. The Chain of Custody form should be in triplicate. One copy of the Chain of Custody form shall be forwarded to the Geologist/Field Engineer by the sampler. The original form and the remaining copy shall accompany the samples.

7.6. Receipt at Destination

The laboratory sample custodian shall inspect the transferred samples to ensure that:

- the seals are intact;
- the labels are affixed and legible;
- Sample Integrity Data Sheets are available where required;
- the physical condition of the samples is acceptable; and
- the samples being transferred directly correspond to those listed on the Chain of Custody form.

If the integrity of the samples is questionable, the laboratory technician shall notify the Golder Project Manager, segregate the unacceptable samples and identify them on the Chain of Custody Form. Otherwise, the laboratory sample custodian and the transporter shall sign, date, and note the time of transfer on the Chain of Custody form. If the transporter is not an employee of Golder Associates Inc., the laboratory sample custodian may identify the carrier and reference the bill of lading number in lieu of

the transporter's signature. The laboratory sample custodian shall retain the remaining copy of the Chain of Custody form and forward the original signed copy to the Geologist/Field Engineer. Appropriate laboratory custody procedures shall be initiated upon completion of transfer of custody in compliance with the laboratory's internal QA program requirements.

7.7. Document Tracking

The copy of the Chain of Custody form recording the initial transfer of samples shall be forwarded to the Geologist/Field Engineer, followed by the completed original. The Geologist/Field Engineer shall track the Chain of Custody form to ensure timely completion and receipt of the original, based on the laboratory acknowledgement due date indicated on the form and/or subcontractor agreement.

After receipt of the completed original, the Geologist/Field Engineer may discard the copy. The completed original Chain of Custody form shall be placed in the project files. Chain of Custody forms determined to be overdue or incorrectly completed shall be referred to the Project Manager for appropriate action.

7.8. Field Change Request

Variation from established guideline requirements may be necessary due to unique circumstances encountered on individual projects. All variations from established guidelines shall be documented on a Field Change Request form (Exhibit D) and reviewed by the Project Manager.

The Project Manager may authorize individual Geologist/Field Engineers to initiate necessary variations. If possible, the request for variation shall be reviewed by the Project Manager prior to implementation. If prior review is not possible, the variation may be implemented immediately at the direction of the Geologist/Field Engineer, provided that the Project Manager is notified of the variation within 24 hours of the implementation, and the Field Change Request is forwarded to the Project Manager within 2 working days of implementation. If the variation is unacceptable to either reviewer, the activity shall be redone or action shall be taken as indicated in the comments section of the reviewed Field Change Request. All completed Field Change Requests shall be maintained in project records.

8.0 REFERENCED GUIDELINES

Golder Associates Technical Guideline TG-1.2-2, "Geotechnical Rock Core Logging."

9.0 ADDITIONAL GUIDELINES AND PROCEDURES

EPA, 2002, “Standard Operating Procedure for Chain of Custody of Samples,” EPA Region 1 Office of Environmental Measurement and Evaluation, North Chelmsford, Massachusetts.

American Society for Testing and Materials, 2004. Standard Guide for Sampling Chain-of-Custody Procedures, ASTM D-4840-99(2004).

Figure 8-1

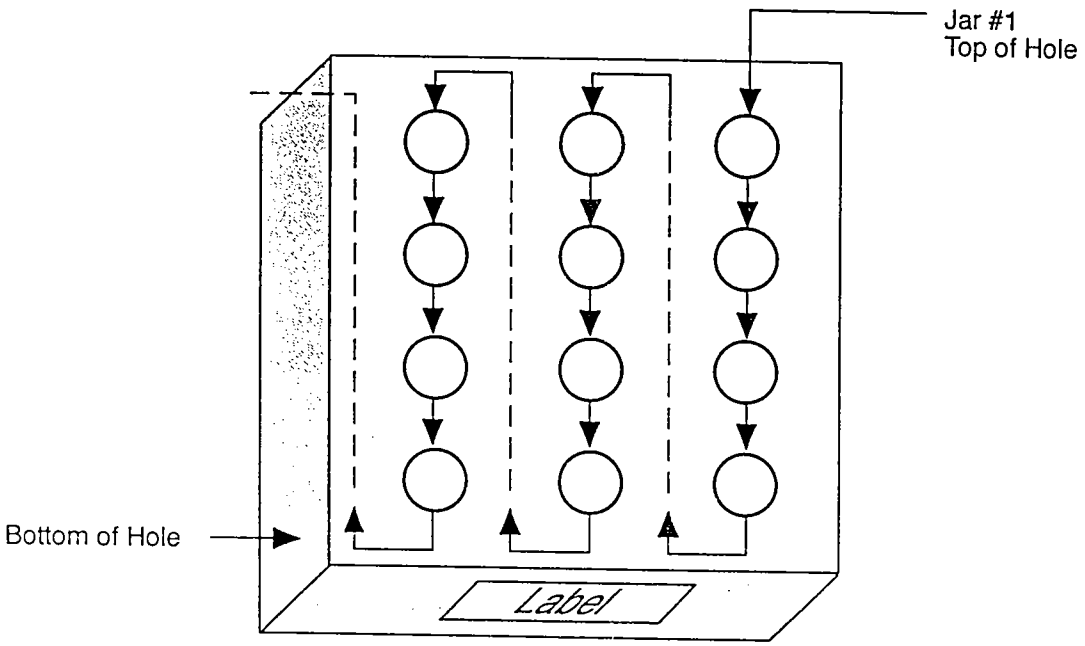


FIGURE **8-1**
SAMPLE CONTAINER PACKING ARRANGEMENT
TP-1.2-23

PROJECT NO IP3 1024.200 DRAWING NO. 66972 DATE 8/15/96 DRAWN BY EA

Golder Associates

EXHIBIT A

Location _____
Job No. _____ Date _____
Boring No. ____ Sample No. _____
Depth _____ Blows _____
Description _____
_____
_____
_____
Driller _____ Engr. _____

Sample I.D. No.

Date _____ Time _____
Station _____ Depth _____
Media _____
Preservative _____
Sampled by _____

Golder Associates

Seal Number
2455

Sent By: _____
Date: _____

EXHIBIT **A**
SEALS AND LABELS
TP-1.2-23

PROJECT NO.IP3-1024 DRAWING NO. 67021 DATE 8/7/96/96 DRAWN BY DD

Golder Associates

EXHIBIT B

SAMPLE INTEGRITY DATA SHEET

Plant/Site _____ Project No. _____
Site Location _____ Sample ID _____
Sampling Location _____

Technical Procedure Reference(s) _____
Type of Sampler _____
Date _____ Time _____
Media _____ Station _____
Sample Type: grab time composite space composite
Sample Acquisition Measurements (depth, volume of static well water and purged water, etc.)

Sample Description _____

Field Measurements on Sample(pH, conductivity, etc.) _____

Aliquot Amount	Container	Preservation/Amount

Sampler (signature) _____ Date _____
Superviser (signature) _____ Date _____

Golder Associates

EXHIBIT **B**
Sample Integrity Data Sheet
TP-1.2-23

PROJECT NO. IPE-1024 DRAWING NO. 67020 DATE 7/17/96 DRAWN BY DD

Golder Associates

EXHIBIT C

PROJECT NO. IP3 1024 DRAWING NO. 67019 DATE 7/17/96 DRAWN BY CB

CHAIN OF CUSTODY RECORD

PROJ. NO.	SITE/LOCATION					NO. OF CON-TAINERS	AMOUNT/ PRESERVATIVE						SEAL NO.	SEAL INTACT ? (Y or N)	REMARKS (with initials)
SAMPLERS: *(Signature)*															
STA. NO.	DATE	TIME	SAMPLE TYPE	MEDIA	SAMPLE IDENTIFICATION										

Relinquished by: *(Signature/Firm)*	Date/Time	Received by: *(Signature/Firm)*	Relinquished by: *(Signature/Firm)*	Date/Time	Received by: *(Signature/Firm)*
Relinquished by: *(Signature/Firm)*	Date/Time	Received by: *(Signature/Firm)*	Relinquished by: *(Signature/Firm)*	Date/Time	Received by: *(Signature/Firm)*
Relinquished by: *(Signature/Firm)*	Date/Time	Received by: *(Signature/Firm)*	Date/Time	Remarks (attachments if necessary)	

EXHIBIT C
CHAIN OF CUSTODY FORM
TP-1.2-23

Golder Associates

EXHIBIT D

FIELD CHANGE REQUEST

Golder Associates

Job/Task Number: _____

Other Affected Documents: _____

Requested Change: _____

Reason for Change: _____

Change Requested by: _____ Date _____

Reviewed by: _____ Date _____
GAI Project Manager

Comments: _____

Reviewed by: _____ Date _____
GAI QA Manager

Comments: _____

Golder Associates Inc.

EXHIBIT **D**
FIELD CHANGE REQUEST FORM
TP-1.2-23

Golder Associates

Technical Procedure

Number: TP-1.2-3
Title: DRILLHOLE LOGGING FOR ROTARY/ CABLE TOOL DRILLING

Prepared by	Approved by	Approved by	Effective Date	Rev. Level
15 Oct 96	10-16-96	10-16-96	10-18-96	-1-

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The hard copy of this document is not controlled and may be obsolete.
Verify current revision level prior to use.

RECORD OF REVISION
TP-1.2-3
Rev. 1

Section	Description of Revision
Throughout	Editorial changes and clarifications
8.3 & Figure 3	Changed Procedure Alteration Checklist to Field Change Request

1. PURPOSE

This procedure establishes a method, consistent with other standard Golder Associates Inc. procedures, for collection of geotechnical and hydrogeological data during rotary or cable tool drilling.

2. APPLICABILITY

This procedure applies to all Golder Associates Inc. personnel or (when invoked through procurement documentation) subcontractors assigned responsibilities for collection of data during rotary or cable tool drilling.

3. DEFINITIONS

None

4. REFERENCES

4.1 Golder Associates Inc. Technical Procedure TP-1.2-1, "Rock Core Drilling and Sampling."

4.2 Golder Associates Inc. Technical Procedure TP-1.2-2, "Geotechnical Rock Core Logging."

4.3 Golder Associates Inc. Technical Procedure TP-1.2-5, "Drilling, Sampling, and Logging of Soils."

4.4 Golder Associates Inc. Technical Procedure TP-1.2-12, "Monitoring Well Drilling and Installation."

5. DISCUSSION

This procedure addresses the collection of hydrogeological and geotechnical data during rotary or cable tool drilling. The standard Record of Drillhole form identified in technical procedure TP-1.2-2, "Geotechnical Rock Core Logging," has been modified to accommodate rotary or cable tool drilling techniques and is described in detail in this procedure. Detailed discussions regarding drilling techniques, rock core logging, and drilling and sampling of soils are located in technical procedures TP-1.2-1, "Rock Core Drilling and Sampling;" TP-1.2-2, "Geotechnical Rock Core Logging;" TP-1.2-5, "Drilling, Sampling, and Logging of Soils;" and TP-1.2-12, "Monitoring Well Drilling and Installation," which are referenced herein.

6. RESPONSIBILITIES

6.1 Project Manager

The Project Manager is responsible for overall management of the logging activities, but may delegate responsibilities to qualified Geologists/Field Engineer. The Project Manager is responsible for approving all variations from the methods established by this procedure, for preparation of the overall scope of work for the logging activity, for preparation of procurement documents for all subcontractors, and for briefing all field personnel on any requirements unique to the particular project.

6.2 Geologist/Field Engineer

The Geologist/Field Engineer is responsible for performing logging in compliance with the requirements of this procedure. The Geologist/Field Engineer is responsible for developing sufficient understanding of the ultimate goals of the investigation in order to properly record all required information and to be able to make sound decisions in the event of unforeseen situations.

7. EQUIPMENT OR MATERIALS

- Record of Drillhole forms for rotary/cable tool drilling (Figure 1)
- Water to rinse cuttings
- Hand lens
- Knife
- Screen strainer
- Field Change Request forms

8. PROCEDURE

8.1 General Information

The Golder Associates Inc. Rotary/Cable Tool Record of Drillhole form is designed specifically for use with air or mud rotary (including reverse circulation) and cable tool drill rigs. The Record of Drillhole form has been designed to facilitate collection of important hydrogeologic and geotechnical data during logging of borehole cuttings. When coring or using sampling equipment which produces intact samples, standard Golder rock coring and soil drillhole logs should be used as specified in technical procedures TP-1.2-2" Geotechnical Rock Core Logging," and TP-1.2-5, "Drilling, Sampling and Logging of Soils."

8.2 Completion of Rotary/Cable Tool Record of Drillhole Forms

An example of a Rotary/Cable Tool Record of Drillhole form used for field logging is attached as Figure 1. An example of a completed Rotary/Cable Tool Record of Drillhole form is included as Figure 2. The Rotary/Cable Tool form is comprised of header, footer, and data sections.

8.2.1 Header and Footer Sections

The header and footer sections contain relevant information about the project and drillhole.

The following data shall be specified on each Record of Drillhole form; please see the example form shown in Figure 2.

Header Section

PROJECT:	Golder Associates Inc. project short title, Owner/Project/State, e.g., ACME/MON. WELLS/WA
PROJECT NO:	Project and task number for drilling, e.g., 899-7777
LOCATION:	Project Location, e.g., Cheney, WA
DRILLING DATE:	Start and completion dates of drilling, e.g., 2 JANUARY, 1989 - 3 JANUARY 1989
DRILL RIG:	Type and model of drilling, e.g., CP 650 W.S. ROTARY
ADDITIVES:	Any drilling fluids or additives, e.g., REVERT POLYMER, None
DATUM:	Elevation datum - Mean Sea Level (MSL) or as specified.
COLLAR ELEVATION:	Surveyed elevation of collar relative to datum, if available
COORDINATES:	Surveyed northing and easting of collar, if available
AZIMUTH:	Surveyed azimuth of inclined borehole at collar (use N/A - not applicable for vertical boreholes)
INCLINATION:	Surveyed inclination from horizontal of borehole at collar or 90 for vertical drillhole.

Note: If collar elevation, coordinates, azimuth, and inclination are not surveyed, this must be noted and the method of estimating these features should be specified on the log or in accompanying notes.

Footer Section

DEPTH SCALE:	Specify the depth scale in feet per inch (or meters per cm) 1 in. = 2 ft. or 1 in. = 5 ft. are typical scales for detailed logging of cuttings samples.
DRILLING CONTRACTOR:	The name of the company conducting the drilling operations.

LOGGED:	The first initial and last name of the field geologist or engineer who logged the drillhole - do not use initials only.
CHECKED:	The first initial and last name of the individual who checked and approved the final logs.
DATE:	The date the final logs were approved.

8.2.2 Data Section

The data section in the Rotary/Cable Tool Record of Drillhole form consist of twelve columns in which to record pertinent information for hydrogeologic and geotechnical documentation.

8.2.2.1 Depth Scale

The depth Scale is used to record the drill hole depth using the scale selected and recorded in the footer section. The scale selected will depend on the stratigraphic complexity of the rock or soil and the level of detail required. A scale of 1 inch = 1 foot, will result in 8 feet of borehole to a page; a scale of 1 inch = 5 feet will result in 40 feet of borehole to a page.

8.2.2.2 Soil/Rock Type Description

The Description section allows for a complete and detailed lithologic description. The soil and rock description systems used by Golder Associates are detailed in technical procedures TP-1.2-5, "Drilling, Sampling, and Logging of Soils," and TP-1.2-2, "Geotechnical Rock Core Logging."

The soil description involves the following general format:

1. Consistency or density,
2. Color,
3. Structural characteristics,
4. Composition with major component in capital letters,
5. Minor characteristics
6. Moisture, and
7. Geologic or stratigraphic name in capital letters and parentheses.

Consistency or density when drilling with cable tool and rotary rigs can usually be estimated by factors such as the drill bit type, rate of penetration, downpressure, etc. Unless undisturbed samples can be taken, structural characteristics should not be included in sample descriptions. If drive-tubes, shelby tubes or split-spoon sampling equipment is used, structural characteristics should be included in soil descriptions. A moisture content shall be included following the description when drilling with air rotary.

Logging soil cuttings from a rotary or cable tool drill rig requires practice. A rotary drill rig will grind or pulverize the soil into a powder or mud before it is discharged from the borehole. A cable tool drill rig will also pulverize the sample during hard tool drilling. It is important to look at all materials being discharged from the borehole to determine the relative amount of fines. It is often useful to then sift the sample through a screen strainer while rinsing in water in order to determine grain size distribution and rock types. Be aware that a significant amount of fines can be lost through the screen during washing. Angularity of grains can be determined from intact faces of the gravel cuttings. Communication with the driller is especially important as he can contribute useful information on the nature and depth of the drilled formation, water table, voids, etc.

The rock description system used by Golder Associates is as follows:

"Weathered State, Structure, Color, Grain or Crystal size, Strength, ROCK TYPE"

When logging rock cuttings it is very important to observe the cuttings closely. Fractures in the rock can often be identified by oxidized surfaces. The rock type and mineral distribution can be identified with a hand lens. A knife can be used to scrape the individual cuttings to determine hardness. Rock cuttings should be rinsed with water before they are logged. Information such as cutting size and angularity should be recorded. Structure can only be estimated from the information available (e.g., 10% of particles in return have fracture faces). Strength descriptions should not be included when cable tooling and rotary drilling unless an undisturbed depth specific sample can be obtained.

8.2.2.3 Rock/Soil Type Graphic Log

The Graphic Log subsection of the Rock Type uses standard lithologic symbols to represent the rock types encountered throughout the drillhole. Contacts between the rock types are represented as follows:

Contact Type	Representation on Graphic Log
Sharp	Solid horizontal line at contact location
Gradation	Solid slanted line from start of gradational change to end of gradational change.
Inferred Contact	Dashed slanted line extending over length of inferred contact.
Erosional	Solid wavy line at contact location.
Fault	Heavy solid horizontal line at contact location.

8.2.2.4 Sample Number

Record consecutive numbers for each sample within a given drill hole, dividing samples by solid horizontal lines at the beginning and end of each sample depth. If a drive sampler is used, sample recovery shall also be included in this column.

8.2.2.5 Sample Type

Record the sample type adjacent to the sample number(s), dividing samples by solid horizontal lines at the beginning and end of each sample (e.g., grab, shelby tube, split-spoon, etc.).

8.2.2.6 Elevation/Depth

Record the depths at the beginning and end of each sample and at lithologic boundaries. Use feet and decimals (tenths) of a foot. Elevations may be filled in after survey data is available.

8.2.2.7 Total Casing Length

The Length of casing when drilling and driving casing is very important. When drilling monitoring wells or supply wells in unconsolidated material, a temporary outer casing is installed to prevent caving of the formation or to seal out formation waters. The temporary casing is pulled back to expose the well screen or removed entirely as the well is completed. It is necessary to know the exact depth of the casing in order to properly set a telescoping well screen or to prevent bridging of materials when backfilling and simultaneously removing outer casing from the borehole.

Casing measurements shall be independently verified by the Geologist/Field Engineer. The total casing length shall include the drive-shoe. Each time a new section of casing is added to the casing string, a new total length shall be written in the Casing Length column under a solid horizontal line at the current depth of the bottom of the drive shoe.

8.2.2.8 Hole Diameter/Casing Diameter/Bit Type

The hole diameter, casing diameter and drill bit type shall be recorded in this column. Any changes in hole diameter, casing or bit type shall be separated by a horizontal solid line at the depth that the change occurred.

8.2.2.9 Weathering/Alteration Index

The Weathering/Alteration Index column is used to record the weathering classification in accordance with the ISRM recommended classification system which is described in technical procedure TP-1.2-2, "Geotechnical Rock Core Logging," and demonstrated in Figure 2. Changes in the Weathering Index are indicated by a solid horizontal line at

the depth of change of an abrupt change, or a solid slanting line covering the range of the weathering change.

8.2.2.10 Moisture/Water Levels/Yield (GPM)

The Moisture/Water Levels/Yield column is used during drilling to record changes in the moisture content of the drill cuttings and to record changes in yield after the water table has been reached. Changes in moisture content shall be separated by a horizontal solid line at the depth that the changes took place. Moisture and water levels should be checked regularly during drilling. When drilling with air and fluids it is often difficult to determine when the water table is reached. The drilling air often dries out the drill cuttings as they are blown out of the drillhole. When drilling with fluids and additives, it is often difficult to determine when the fluid discharge increases and the water table has been penetrated. To avoid missing important water bearing zones, water levels should be checked frequently. Water levels can be checked during shut downs by lowering a water level indicator through the drill rods to the bottom of the borehole. Water levels shall be measured at the beginning and end of each shift. Yield can be measured by raising the drill bit 1-2 feet off the bottom of the drillhole and air lift pumping water into a five gallon bucket. Monitoring the drill fluid level in the settling tank or pit can provide information of drillhole intervals that may be producing groundwater or losing drill fluid to the formation. Any time a water level is taken or the yield is measured, the instruments and method shall be documented in the notes column of the drillhole log.

8.2.2.11 Time/Rate of Advance

The Time/Rate of Advance column serves several purposes. The time shall be recorded regularly during drilling and each time the driller starts and stops drilling. Any shutdowns, welding time, problems, etc. should be recorded in the time column. The time is entered at the depth that the particular event occurred on the drillhole log. Always record events in military or 24 hour time format; e.g., 1 PM should be recorded as 1300. From the Time/Rate of Advance column, the rate of advance can be calculated for any specific depth and any problems or shutdowns may be referenced to the History of Hole form for explanation. The History of Hole form is discussed in TP-1.2-5, "Drilling, Sampling, and Logging of Soils," and is used to record events associated with the drilling of each hole.

8.2.2.12 Notes, Drilling Method, Instrumentation

The Notes, Drilling Method, Instrumentation column shall be used to record any information that affects the drilling of the borehole, the quality of the samples, delays shutdowns, standby and any information that might be misinterpreted from the rest of the drillhole log. Detailed explanations may be referenced to the History of Hole form. Any water or additives should be documented in the notes column. The manufacturer, common name, and quantity of all materials added to the borehole shall be documented.

8.3 Field Change Request

Variations from established procedure requirements may be necessary due to unusual field situations or unique client requirements. The Project Manager may delegate authority to the onsite Geologist/Field Engineer to initiate variations as necessary to respond to such situations; however, all variations from established procedures shall be documented on Field Change Request form (Figure 3) and verbally reported to the Project Manager within 24 hours. The Field Change Request shall be submitted to the Project Manager and the QA Manager for formal review and approval within 2 working days. Disapproval of a Field Change Request shall require re-performance of the logging activity or other appropriate resolution as directed by the Project Manager.

tp1'2-3.rv1

RECORD OF DRILLHOLE (ROTARY/CABLE TOOL)

Sheet of

PROJECT:
PROJECT NO:
LOCATION:

DRILLING DATE:
DRILL RIG:
ADDITIVES:

DATUM:
COORDINATES N:
AZIMUTH:

COLLAR ELEV:
E:
INCLINATION:

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	(ELEVATION) DEPTH	TOTAL CASING LENGTH	HOLE DIAMETER/ CASING DIAMETER/ BIT TYPE	WEATHERING INDEX	MOISTURE, WATER LEVELS YIELD (GPM)	TIME/ RATE OF ADVANCE	NOTES DRILLING METHOD INSTRUMENTATION

SCALE:
DRILLING CONTRACTOR:
DRILLER:

LOGGED:
CHECKED:
DATE:

Golder Associates

FIGURE 1
RECORD OF DRILLHOLE FORM (ROTARY/CABLE TOOL)
TP-1.2-3

PROJECT NO. IP3 1024.200 DRAWING NO. 68272 DATE 10/14/96 DRAWN BY EA

RECORD OF DRILLHOLE DNAPL-1
(ROTARY/CABLE TOOL)

Sheet 1 of 2

PROJECT: ACME/MON.WELLS/WA
PROJECT NO: 899-7333.444
LOCATION: CHENEY, WA

DRILLING DATE: 2 JANUARY, 1990
DRILL RIG: CP 650 W.S. ROTARY
ADDITIVES: NONE

DATUM: MSL
COORDINATES N: 68345
AZIMUTH: NA

COLLAR ELEV: NA
E: 23112
INCLINATION: 90°

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	(ELEVATION) DEPTH	TOTAL CASING LENGTH	HOLE DIAMETER/ CASING DIAMETER/ BIT TYPE	WEATHERING INDEX	MOISTURE WATER LEVELS YIELD (GPM)	TIME/ RATE OF ADVANCE	NOTES DRILLING METHOD INSTRUMENTATION
0	0.0-2.0 - COMPACT, MODERATE BROWN (5YR 4/2). FINE TO MEDIUM SAND, SOME GRAVEL, TRACE SILT, ABUNDANT ROOTS, MOIST (TOPSOIL)		1	GRAB SAMPLES			10-INC DIA. STEEL CASING	NA	MOIST	0830	STARTED DRILLING AND DRIVING 10-INCH DIA. STEEL CASING WITH 10-INCH TRICONE BIT. AIR CIRCULATION DRILLING WITH CASING HAMMER. GRAB SAMPLING HOLDING BACK DRILL BIT.
	2.0-31.0 - DENSE, MODERATE BROWN (5YR 4/2). SILTY SAND AND GRAVEL, TRACE CLAY, GRAVELS ARE SUBANGULAR, MOSTLY BASALT, DAMP (GLACIAL TILL)		2		2.0				DAMP		
5			3		5.0					0850	
10			4		10.0					0910	
										0915	DOWN BROKEN HOSE. SEE HISTORY-OF-HOLE (HOH)
										0930	
15			5		15.0	20.0 +10.2				0945	
					18.0	30.2	10-INC DIA. TRI-CONE BIT			1000	10-INCH DIA. CASING TO 18.0 FEET. SWITCHED TO 6-INCH TRI-CONE BIT.
										1115	
20			6		20.0					1120	6-ICH CASING TELESCOPED TO 18.0 FEET. WELDED ON 10.2 FOOT SECTION OF 6-INCH DIA. STEEL CASING. DRILL AND DRIVE 6-INCH DIA. STEEL CASING FROM 18.0 FEET.
25					25.0	30.2 +10.0	6-INC DIA. STEEL CASING W/DRIVE SHOE			1130	
			7		27.0	40.2			NO WATER	1135 1220	WELDED CASING, CHECKED FOR WATER IN BOTTOM OF BOREHOLE WITH WATER LEVEL INDICATOR AFTER 30 MIN SHUTDOWN.
30										1225	
	31.0-33.0 - SOFT, DUSKY YELLOWISH BROWN (10YR 2/2). CLAY, MOIST		8	SH	31.0	40.2 -4.2			MOIST	1227 1240	SHUTDOWN IN CLAY, TRIPPED OUT. SAMPLED WITH SHELBY TUBE. SEE HOH
	33.0-40.0 - MODERATELY WEATHERED, HIGHLY FRACTURED, DUSKY YELLOWISH BROWN (10YR 2/2). APHANITIC, VESICULAR, WEAK, BASALT, DAMP - FRACTURE SURFACES FeOx STAINED - RARE CLAY COATINGS ON FRACTURE SURFACES - 35.0-36.0 - VOID IN ROCK		9	GRAB	33.0	36.0		W3	DAMP	1300 1320	CUT CASING, CHECKED BOREHOLE FOR WATER - NONE. DRILLING OPEN HOLE FROM 33.0 FEET.
35										1325	35.0-36.0 - VERY FAST DRILLING, NO RECOVERY, VOID IN ROCK.
										1325	
											3000 PSI DOWN PRESSURE.
40										1410	

SCALE: 1 INCH = 5 FEET
DRILLING CONTRACTOR: KELLY BROTHERS
DRILLER: BOB KELLY

LOGGED: J. GEOHEAD
CHECKED:
DATE:

Golder Associates

FIGURE 2
EXAMPLE RECORD OF DRILLHOLE (ROTARY/CABLE TOOL)
TP-1.2-3

IP3 1024.200/68273/10-15-96

RECORD OF DRILLHOLE DNAPL-1 (ROTARY/CABLE TOOL)

Sheet 2 of 2

PROJECT: ACME/MON.WELLS/WA
PROJECT NO: 899-7333.444
LOCATION: CHENEY, WA

DRILLING DATE: 2 JANUARY, 1990
DRILL RIG: CP 650 W.S. ROTARY
ADDITIVES: NONE

DATUM:
COORDINATES N: 68345
AZIMUTH: NA

COLLAR ELEV: NA
E: 23112
INCLINATION: 90°

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	(ELEVATION) DEPTH	TOTAL CASING LENGTH	HOLE DIAMETER/ CASING DIAMETER/ BIT TYPE	WEATHERING INDEX	MOISTURE WATER LEVELS YIELD (GPM)	TIME/ RATE OF ADVANCE	NOTES DRILLING METHOD INSTRUMENTATION
40	40.0-61.0 - FRESH, APHANITIC, MEDIUM DARK GRAY (N4), (BASALT), DRY		10	GRAB SAMPLES FROM CYCLONE	42.5	36.0	6-INCH TRI-CONE BIT	W1	DRY	1410	10.000 PSI DOWNPRESSURE
										1415	
										1435	SWITCHED TO DOWN-THE-HOLE HAMMER BIT
45			11		45.0				STARTED MISTING DAMP CUTTINGS	1440	
										1445	STARTED DRILLING WITH LIGHT MIST (1/4 GAL/MIN) BECAUSE OF SURFACE DUST PROBLEMS. WATER FROM CHENEY CITY WATER.
50			12		50.0					1455	
55	54.0-54.5 - FRACTURES IN ROCK, DARK REDDISH BROWN (10YR 3/4), COATED CUTTINGS AND FRACTURE SURFACES.		13		55.0		6-INCH DIA. DOWN-THE-HOLE HAMMER DRILL BIT			1510	
60					60.0				MOIST TO WET	1525	MOISTURE INCREASES - SHUT OFF MIST
	61.0-71.0 - MODERATELY WEATHERED, HIGHLY FRACTURED, APHANITIC, VESICULAR, DUSKY YELLOWISH		14					W3	WET - 1/4 GPM	1530 1610	SHUTDOWN TO CHECK FOR WATER S.W.L. AT 59.3 FEET BELOW SURFACE AFTER 35 MINUTES. SEE HOH. STARTED DRILLING, WATER DISCHARGING FROM CYCLONE (~1/4 GAL/MIN). YIELD INCREASES DOWNWARD DURING DRILLING.
65					65.0					1625	
			15								
70									3.2 GPM		
					70.0				57.0 SWL	1635 1710	SHUTDOWN, CHECKED STATIC AFTER 15 MINUTES - 57.0 FEET BELOW SURFACE. AIR LIFT PUMPED WATER FOR 5 MIN. AT ~3 GPM. 3 MIN. RECOVERY TO 57.0 FEET. YIELD STARTED DECREASING AT 71.0 FEET.
	71.0-75.0 - FRESH, APHANITIC, MEDIUM DARK GRAY (N4), MEDIUM STRONG, (BASALT)		16					W1	DECR. YIELD		
75									1.5 GPM	1730	TERMINATED DRILLING, STARTED WELL DEVELOPMENT BY AIR LIFTING WATER. SEE HOH.
	75.0 FEET TOTAL DEPTH										
80											

SCALE: 1 INCH = 5 FEET
DRILLING CONTRACTOR: KELLY BROTHERS
DRILLER: BOB KELLY

LOGGED: J. GEOHEAD
CHECKED:
DATE:

Golder Associates

IP3 1024.200/68274/10-14-96

FIGURE 2 (cont)
EXAMPLE RECORD OF DRILLHOLE (ROTARY/CABLE TOOL)
TP-1.2-3

FIELD CHANGE REQUEST

Golder Associates

Job/Task Number: _____

Other Affected Documents: _____

Requested Change: _____

Reason for Change: _____

Change Requested by: _____ Date _____

Reviewed by: _____ Date _____
GAI Project Manager

Comments: _____

Reviewed by: _____ Date _____
GAI QA Manager

Comments: _____

FIGURE 3
FIELD CHANGE REQUEST FORM
TP-1.2-3

Golder Associates

Technical Procedure

Number: TP-1.2-18
Title: SAMPLING SURFACE SOIL FOR CHEMICAL ANALYSIS

Prepared by	Approved by	Approved by	Effective Date	Rev. Level
9/4/96	9/4/96	9-4-96	9-12-96	-5-

1. PURPOSE

This technical procedure establishes uniform methods for sampling surface soils for chemical analysis.

2. APPLICABILITY

This Technical Procedure shall be used by all Golder Associates Inc. (Golder) personnel sampling surface soils for chemical analysis.

3. DEFINITIONS

3.1 Surface Soil

Surface soil is defined as consolidated soil on the land surface or as exposed by an excavation or boring within twenty (20) feet of the land surface.

3.2 Sampling Interval

The sampling interval is defined as the stratigraphic depth represented by the soil sample.

3.3 In Situ Soils

The term in-situ soils refers to soils as they occur in place within the soil column.

4. REFERENCES

Golder Associates Technical Procedure TP-1.2-23, "Chain of Custody."

Golder Associates Technical Procedure TP-1.1-2, "Geodetic Surveys."

5. DISCUSSION

None

6. RESPONSIBILITIES

6.1 Sampling Technician

The Sampling Technician is responsible for completing the sampling assignment in accordance with this Technical Procedure and governing project plans or instructions.

6.2 Task Leader

The Task Leader is responsible, within the guidelines of governing plans or instructions, for determining which soils shall be sampled and for monitoring the sampling process to ensure that procedures and documentation are in accordance with this document.

6.3 Project Manager

The Project Manager or a qualified designee is responsible for determining the type of chemical analyses to be performed on soil samples, and for defining such requirements to project staff through appropriate plans or instructions.

7. EQUIPMENT AND MATERIALS

- Brunton compass, 0° to 360° divisions;
- site map and clipboard;
- bound field logbook or field report forms (Exhibit A);
- assorted standard field equipment (e.g., hammers, post-hole digger, shovel, hand auger) for exposing soils to be sampled;
- measuring tape;
- engineer's rule (six feet long, with 0.10 foot graduations);
- indelible ink pens;
- two-inch wood stakes and colored flagging material;
- if required, sampling equipment appropriate for soils to be analyzed for non-volatile constituents; all such equipment shall be metal (steel, stainless steel or aluminum) and may include hand augers, hand scoops, sampling thiefs, sampling dredges, core samplers, or sampling triers. If volatile constituents are to be analyzed in the soil samples, sampling equipment shall be designed to minimize exposure to the atmosphere. As an example, a metal drive tube appropriate for the size of the soil particles and slightly smaller in diameter than the wide-mouth glass sample bottles may be used, with appropriate sample extraction accessories;
- sample bottles, sized appropriately for the desired sample and soil particle size;
- Chain of Custody records, seals, and sample labels as required by procedure TP-1.2-23, "Chain of Custody";
- appropriate decontamination solutions such as organic free distilled/deionized water, non-phosphate detergent, tap water;
- decontamination equipment such as brushes and sprayers, and drums or applicable plan or containers for capturing decontamination waste solution; and

- thermometer controlled in accordance with Golder's quality procedure for calibration of measuring and test equipment.

8. PROCEDURE

8.1 Sample Location

Location mapping shall be to the level of detail required by the applicable plan or instructions, and sound engineering and geologic practice. If the base map for the sampling site is of sufficient accuracy, the sample location may be approximated within a 10' radius and physically identified by a wood stake marker. If the base map does not have the required accuracy, locations shall be described by either (1) tape measurement from three permanent features identifiable on the base map; (2) measured along a compass bearing from a permanent feature; or (3) triangulated with compass bearings from three permanent features identifiable on the base map. Compasses may be used only when the site does not contain magnetic or large metal objects. The locations so derived will be identified by a wood stake marker with test pit designation, and recorded as described in Section 8.2. When required by project directive, all location markers will be geodetically surveyed in accordance with TP-1.1-2, "Geodetic Surveys."

8.2 Documentation

Final sample location, sample types and numbers, and relevant sampling events (including on-site personnel and all visitors) shall be recorded on Field Report forms (Exhibit A) or bound field logbooks. Events shall be recorded chronologically, with the time of each event noted.

8.3 Decontamination

All sampling equipment shall be decontaminated prior to the start of sampling activities and between each use. Unless other decontamination procedures are specified in the project plans or instructions, the following steps will be followed. The sampling equipment shall be washed with non-phosphate detergent solution. Brushes shall be used to aid in removing all visible soil or grit. A tap water rinse shall be used to thoroughly remove all detergent solution. The final rinse shall be with organic free distilled/deionized water. All waste wash solutions shall be captured and disposed of in the manner defined by the applicable project plan or instruction, in compliance with applicable regulatory requirements.

8.4 Sampling

The soils to be sampled shall be exposed prior to sample acquisition. If the upper six inches of soils are to be sampled, then surface vegetation shall be removed. If samples are to represent discrete depth intervals below land surface, then overlying soils shall be removed by a shovel, post-hole digger, hand auger, or other appropriate method to the desired interval. For loose watery sediments from stream bottoms, a pond sampler, sampling dredge, pail, or ladle can be used. The sediment sample should be allowed to settle and the extra water decanted prior to transferring samples to containers. For cohesive wet or dry stream-bottom samples, a vertical-pipe, sampling dredge, or core sampler can be used and driven into the stream bed to the

selected depth. An in-situ soil sample shall be obtained from the desired sampling interval. If the required analyses do not include volatile constituents, an in-situ soil sample can be obtained using a hand scoop, hand auger, sampling thief, or sampling trier. The soils shall be visually inspected and immediately put into the appropriate sample bottle as required by the governing project plan or instruction. No preservatives shall be added to the sample.

If soils are to be analyzed for volatile constituents, the sample shall be obtained from the desired interval using a drive tube sampler. Contact between the atmosphere and the sample must be minimized; the drive tube sampler shall be driven into the materials with a hammer, and the sample extruded directly into the appropriate sample bottle. An air-tight cap shall be immediately placed on the sample bottle; no preservatives shall be added.

If a backhoe is used to expose sampling intervals for analysis of volatile constituents, a hand auger or drive tube may be used to sample the test pit walls or floor when the test pit is less than four (4) feet deep. If the test pit is greater than four (4) feet, a relatively undisturbed sample may be obtained from the backhoe bucket using a drive tube sampler.

8.5 Composite Samples

If soil sample composites are to be established, equal volumes of individual samples shall be added together for the composite sample. At least three small, equal sized samples from several points within a five foot radius shall be collected. Samples will be placed into a clean, decontaminated stainless steel container and each portion will be stirred together into one composite. The composite sample shall be given an individual sample number, and the sample number of each contributing sample recorded in the field logbook or Field Report form.

8.6 Sample Labeling, Handling, and Shipment

Samples shall be immediately labeled, sealed with a tamper-proof seal and relevant data recorded on individual Chain of Custody forms as required by TP-1.2-23, "Chain of Custody." Samples shall be placed in a chilled cooler at approximately 4° C, $\pm$ 2°C, as soon as possible. A thermometer shall be placed in the cooler for temperature monitoring purposes. The cooler shall remain in sight of the Sampling Technician at all times, or be kept in locked storage, as required by TP-1.2-23.

Samples shall be forwarded to the analytical laboratory accompanied by the Chain of Custody record, in compliance with TP-1.2-23 requirements. When samples are ready for shipment, the Task Leader shall release the sample to the carrier, who shall also sign the custody form. The Chain of Custody form is in triplicate. One copy of the form shall be retained by the Task Leader; the original form and the remaining copy shall be shipped with the sample. Upon receipt at the laboratory, the laboratory custodian shall verify the integrity and identification of the sample, sign the form, and return the original copy to the Task Leader or Project Manager. All originals shall be retained in the project records.

8.7 Site Restoration

Any excavation or hole made to obtain samples shall be backfilled with the excess material removed from the hole, unless other requirements are invoked by governing plans or instructions.

8.8 Field Change Request

Variation from established procedure requirements may be necessary due to unique circumstances encountered on individual projects. All variations from established procedures shall be documented on a Field Change Request form (Exhibit B) and reviewed by the Project Manager and the QA Manager.

The Project Manager may authorize individual Field Engineers to initiate variations as necessary. If practical, the request for variation shall be reviewed by the Project Manager and the QA Manager prior to implementation. If prior review is not possible, the variation may be implemented immediately at the direction of the Field Engineer, provided that the Project Manager is notified of the variation within 24 hours of implementation, and the Field Change Request is forwarded to the Project Manager and QA Manager for review within 2 working days of implementation. If the variation is unacceptable to either reviewer, the activity shall be reperformed or action shall be taken as indicated in the Comments section of the Field Change Request form.

All completed Field Change Request forms shall be maintained in the project records.

GOLDER ASSOCIATES
4104 148th Avenue NE
Redmond, Washington 98052

(206) 883-0777

DATE	JOB NO
PROJECT	
LOCATION	
CONTRACTOR	OWNER
WEATHER	TEMP °at AM °at PM
PRESENT AT SITE	

TO _____

_____

_____

THE FOLLOWING WAS NOTED:

COPIES TO _____

_____

FIELD REPORT

SIGNED _____

EXHIBIT **A**
FIELD REPORT
TP 1.2-18

PROJECT NO. IP3 1024 DRAWING NO. 48020 DATE 1/18/94 DRAWN BY TK

Golder Associates

FIELD CHANGE REQUEST

Golder Associates

Job/Task Number: _____

Other Affected Documents: _____

Requested Change: _____

Reason for Change: _____

Change Requested by: _____ Date _____

Reviewed by: _____ Date _____
GAI Project Manager

Comments: _____

Reviewed by: _____ Date _____
GAI QA Manager

Comments: _____

APPENDIX C
QUALITY ASSURANCE/QUALITY CONTROL PLAN

REPORT

QUALITY ASSURANCE PROJECT PLAN FOR GROUNDWATER AND SURFACE WATER SAMPLING

Monsanto Soda Springs Facility, Soda Springs, Idaho

Submitted To: Monsanto Company
Soda Springs Plant
Highway 34
Soda Springs, ID 83276 USA

Submitted By: Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052 USA

Distribution:

3	Copies	Monsanto, Soda Springs, Idaho
1	Copy	EPA Region X, Seattle, Washington
1	Copy	IDEQ-Pocatello, Idaho
1	Copy	Stochos Environmental Inc.
2	Copies	Golder Associates Inc., Redmond, Washington

June 2011 **913-1101-002.002.2A**

A world of capabilities delivered locally

Golder Associates

Table of Contents

List of Tables

Approvals

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(425) 883-0777

June 9, 2011
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Date

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Date

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_____
Date

_____
Clyde Cody, Idaho Department of Environmental Quality
clyde.cody@deq.idaho.gov
(208) 373-0556

_____
Date

1.0 PROJECT DESCRIPTION

1.1 Project Objective and Historical Background

This QAPP has been written to support specific procedures, analytical methods, and other detailed instructions performed in conjunction with elements of the "Groundwater and Surface Water Sampling and Monitoring Plan" (Golder 2011). The QAPP was generated in significant accordance with the document EPA QA/R-5, „EPA Guidance for Quality Assurance Project Plans‟ (EPA 2002a) and provides procedures for making accurate measurements and obtaining representative, accurate, and precise analytical data. Work plan tasks include sampling of monitoring wells, springs, non-contact cooling water, and surface water.

1.2 Site Description

A discussion of the Monsanto Soda Springs site is provided in the Phase II Remedial Investigation Report for the Soda Springs Elemental Phosphorus Plant (Golder 1995).

2.0 PROJECT ORGANIZATION

2.1 Organizational Structure

Project directors and their contact information are provided in the table below. The organizational structure for field activities for the Monsanto Soda Springs site is provided in the following paragraphs.

	Golder Project Manager	**Monsanto Project Coordinator**
Contact:	David Banton	Jim McCulloch
Company:	Golder Associates Inc.	Monsanto Chemical Company
Address:	18300 NE Union Hill Road, Suite 200 Redmond, Washington 98052-3333	PO Box 816 Soda Springs, Idaho 83276
Phone:	(425) 883-0777 Work (425) 503-9331 (cell)	(208) 547-1233
Facsimile:	(425) 882-5498	(208) 547-3312

Project Manager & Quality Assurance Coordinator

The Project Manager, Mr. David Banton, is responsible for planning and executing all environmental sampling and analysis and for preparation of analytical data reports, and all associated Technical memoranda including submittals to the Idaho Department of Environmental Quality (IDEQ) and the US Environmental Protection Agency (USEPA). The Project Manager prepares the specifications for, and administers the subcontracts for laboratory analysis. Mr. Banton also acts as the Quality Assurance Coordinator and, at his discretion, reviews aspects of quality control or directs Golder technical staff to perform tasks to determine if data quality objectives are being met.

Groundwater and Surface Water Sampling and Monitoring Plan Coordinator and Site Health & Safety Coordinator

Mr. Michael Klisch will act as Golders‟ sampling and monitoring plan coordinator to make contacts for appropriate scheduling, direct subcontractors in the field, collect environmental quality field samples, and to perform and report on other field operations. Mr. Klisch will also act as Golders‟ on-site Health & Safety Coordinator for safe and effective actions by Golder field employees. Mr. Klisch confers with the Project Manager and provides information to guide completion of the field tasks and to ensure all activities are conducted in accordance with the Groundwater and Surface Water Sampling and Monitoring Plan.

Health & Safety Officer

The Health and Safety Officer, Ms. Amanda Cote, is responsible for review and implementation of the site Health and Safety Plan (HASP) and communicating the key elements of on-site safety to the field personnel, including; personal protective measures and equipment, emergency preparedness and incident protocol.

Chemist/Validator

The Chemist/Validator, Mr. Tom Stapp reports to the Project Manager. He is responsible for coordinating with the subcontracted laboratories to obtain the required analyses, maintain sample tracking, perform data validation actions and to ensure proper recording of validated data to the database. The Chemist/Validator is responsible for the review and validation of laboratory analysis reports in accordance with guidance documents available from EPA. Mr. Stapp directs maintenance of the data files in the project database, and the generation of spreadsheets and report formats of archived data.

Field Sampling Personnel

Golder Field Sampling Personnel will be selected as necessary for completion of Work Plan elements by the Golder Project Manager. The Field Sampling Personnel are responsible for safe conduct while collecting all field samples in accordance with the Groundwater and Surface Water Sampling and Monitoring Plan and QAPP, and performance of other Technical Procedure actions as cited in the Groundwater and Surface Water Sampling and Monitoring Plan. In addition, Field Sampling Personnel are responsible for accumulation, organization, and maintenance of all information collected during field activities (including sampling logbook, daily activity logbook, chain-of-custody forms, and water-level measurements).

2.2 Use of Subcontractors

SVL Analytical, Inc., located in Kellogg, Idaho has been selected to perform the primary analytical testing and Analytical Resources, Inc., located in Seattle, Washington will perform the primary split sample analysis. Both laboratories hold certifications from the State of Idaho or by reciprocal agreement with other State certifications appropriate to the analytical testing identified in this QAPP. A summary of certifications for each laboratory is as follows:

2.2.1 SVL Analytical, Inc. Certifications

- State of Idaho Department of Health and Welfare, Drinking Water Laboratory Certification for Total Coliform and E. Coli Analytes
- National Environmental Laboratory Accreditation Program (NELAP) Certification through the Florida Laboratory Accreditation Program for:
  - Drinking water - primary inorganic contaminants

- Drinking water - secondary inorganic contaminants
- Drinking water - radiochemistry
- Non-potable water - general chemistry
- Non-potable water - metals
- Solid and chemical materials- general chemistry
- Solid and chemical materials - metals

- Adherence to NPDES Testing Standards

2.2.2 Analytical Resources, Inc. Certifications

- National Environmental Laboratory Accreditation Program (NELAP) Certification through the Oregon Laboratory Accreditation Program for drinking water, non-potable water, solids/ chemical wastes, and tissues.
- Accredited for analytical methods listed in QAPP Tables under categories of drinking water, non-potable water, or solids/ chemical wastes, by the Washington State Department of Ecology.
- Adherence to NPDES Testing Standards.

2.2.3 IAS Envirochem Inc. Evaluation

IAS Envirochem Inc. of Pocatello, Idaho is being evaluated as an alternate laboratory for split sample analysis. Copies of their certifications and laboratory QAPP have been requested.

3.0 DATA QUALITY OBJECTIVES

3.1 Appropriate Field Procedures & Analytical Methods

The primary objective of the field activities are to collect representative groundwater, surface water, spring, and non-contact cooling water samples that can be used to characterize groundwater and surface water quality at the Monsanto Soda Springs site and provide information to assess long and short-term water quality changes.

Tables QAPP-2 through QAPP-4 list all analytical parameters of interest defined for water sample collection during sampling activities. The complete list of parameters may include metal analyses using EPA 6010 or EPA 6020 from „Test Methods for Evaluating Solid Wastes" (EPA 2007), and various methods for general chemistry parameters found in the aforementioned documents as well as „Standard Methods for the Examination of Water and Wastes" (APHA 1998). All surface water, groundwater, spring, and non-contact cooling water samples will have standard field parameter list indicators measured including temperature, pH, conductivity, dissolved oxygen, and turbidity.

The objectives for analytical data quality are defined in terms of the quantitation limits achievable using the referenced analytical methods, and in terms of the resulting goals for precision, accuracy, representativeness, completeness, and comparability of analytical data. Quantitation limits are provided for each analytical parameter in Tables QAPP-2 through QAPP-4 and are cross-referenced to an applicable standard EPA reference method. The quality objectives established for long-term monitoring are described as follows:

- Precision: analytical precision shall be reported on field duplicates and matrix spike/ matrix spike duplicate sample data as required by the governing EPA reference methods cited in Tables QAPP-2 through QAPP-4. Specific precision criteria for the governing methods as required by data validation guidelines, are presented in Tables QAPP-2 through QAPP-4 and in the Quality Control Summary tables (Tables QAPP-6 through QAPP-8).
- Accuracy (Bias): accuracy shall be reported from certified standard recovery, blank spike recovery, and matrix spike recoveries as required by the governing EPA reference methods cited in Tables QAPP-2 through QAPP-4. Specific accuracy criteria for the governing methods as required by data validation guidelines are provided in Tables QAPP-2 through QAPP-4 and in the Quality Control Summary tables (Tables QAPP-6 through QAPP-8).
- Representativeness: Goals for sample representativeness are addressed qualitatively by the sampling locations and intervals defined in the Work Plan. In addition, the use of standard procedures for sample acquisition (as described in Section 4.0 of this QAPP) will facilitate the collection of representative data.
- Completeness: Completeness is defined as the percentage of valid analytical determinations with respect to the total number of requested determinations in a given sample delivery group; completeness goals are established at 90 percent. Failure to meet this criterion shall be documented and evaluated in the data validation process

described in Section 6.0 of this QAPP, and corrective action taken as warranted on a case-by-case basis.

- Comparability: Approved analytical procedures shall require the consistent use of the reporting techniques and units specified by the EPA reference methods cited in Tables QAPP-2 through QAPP-4 in order to facilitate the comparability of data sets from sequential sampling rounds in terms of their precision and accuracy.

4.0 SAMPLING AND OTHER FIELD PROCEDURES

4.1 Selected Procedures

Technical procedures have been developed to support sampling activities, monitoring actions, data validation, and other technical activities. Reference to technical procedures applicable to individual activities, are provided in Table QAPP-1, („Golder Technical and Quality Procedures List"), and complete copies for selected technical procedures are provided in Appendix C of the Groundwater and Surface Water Sampling and Monitoring Plan.

Technical Procedures are provided as guidance to technical personnel and as such, require the specific circumstance of application or the knowledge of the field scientist to appropriately apply the guidance criteria. Some technical procedures may have duplicate or similar information provided in other technical procedures that is necessary to be included to provide continuity to the content of the document. Significant changes in the field to technical procedure guidance will be identified and included on a Field Change Request form (TG-1.2-23, "Chain of Custody").

4.2 Water Sampling

Groundwater, surface water, spring, and non-contact cooling water quality samples will be collected to provide information to characterize groundwater and surface water quality and evaluate water quality trends. Samples will be collected from monitoring wells, Plant production wells, springs, surface water locations along Soda Creek, and non-contact cooling water. Groundwater levels will be measured in monitoring wells. Flows will be measured at surface water sampling locations and from springs. The sampling work will be conducted annually in late May or early June.

The Groundwater and Surface Water Sampling and Monitoring Plan; and Table QAPP-1 present technical guidance documents with procedures to collect groundwater and surface water samples and measure groundwater elevations and surface water flows. Substantial changes in the field to established procedures for water quality sampling, groundwater elevation measurement, and flow measurement will be subject to a „Field Change Request" requiring approval from the Golder Project Manager.

4.3 Document Distribution, Variation Request, and Change Control Considerations

The technical procedures and all other procedures cited in this QAPP are subject to the distribution control requirements of QP-5.1, "Document Preparation, Distribution, and Change Control." Variations from established field procedure requirements may be necessary in response to unique circumstances encountered during sampling activities. All such variations must be documented on a Field Change Request (FCR) form and submitted to the Project Manager for review and approval. A copy of the Field Change Request form is presented in TG-1.2-23 "Chain of Custody", Exhibit D.

The Project Manager or his assigned Field Sampling Personnel are authorized to implement non-substantive variations based on immediate need, provided that the Project Manager is notified within 24 hours of the variation, and the FCR is forwarded to the Project Manager for review within 2 working days. Substantive variations require notification of the Project Manager, the Work Plan Coordinator, and Potentially Liable Party (PLP) representative prior to implementation, and by forwarding an FCR for review within 2 working days. If the variation is unacceptable to any or all of the reviewers, the activity shall be re-performed or other corrective action taken as indicated in the "Comments" section of the FCR. A copy of the FCR shall be included with all field reports, as well as the data validation report. Changes to the requirements of this QAPP or the Work Plan shall be controlled through the Interim Change Notice (ICN) procedures as discussed in Section 6.5.2 of QP-5.1.

4.4 Sample Quantities, Types, Locations, and Intervals

Sample quantities, types, locations, and intervals for the groundwater shall be as specified in the Groundwater and Surface Water Sampling and Monitoring Plan. Field quality control samples shall be included in the minimum quantities specified in Section 7.0 of this QAPP. Appropriate documentation of the purpose of the sample shall be maintained in the field log, and identified by the assigned sample number; copies of sample identification records shall be separately provided to the data validator. See Section 6.0 of this QAPP.

4.5 Sample Identification and Labeling Requirements

Sample labels will be attached to each sample container with an assigned field sample identification number applied as each sample is collected during the field activities. The number system will appear on each sample bottle or container collected and will identify a unique sample ID number applied to one collection sequence for one sample, regardless of the number of bottles and containers collected. The number system will ensure field QC samples will remain indistinguishable from the field locations. The label will contain the sampler"s initials, one collection date, and one collection time appropriate for each sample, and will be cross referenced by the sample number to identify the location, depth, or monitoring well number with geological data in the field notes. An example label is provided as follows:

Golder Associates

Sample Number:_____

Preservative:_____

Analysis:_____

Sample Date: __/ / **Time:** _____

Sampler: _____

Each sample bottle label will also identify the laboratory analysis to be performed, noting the identified method number as stated in Tables QAPP-2 and QAPP-3 and the preservative added for the appropriate analytical parameter as indicated on the bottle label. Identification numbers shall be recorded on the field report logs and sample integrity data sheets with the applicable sampling procedures, and on the chain of custody/sample analysis request form supplied to the analytical laboratory.

4.6 Sample Container Type, Volume, Preservation, and Handling Requirements

All sample containers, container preparation, preservatives, trip blank (as necessary), and sample storage chests shall be provided by the analytical laboratory as part of their agreement for services. Sample container type, volume requirements, preservation requirements, and special handling requirements are listed by analytical category in Table QAPP-5 for all water matrices.

All samples shall be sealed, labeled, properly identified, and submitted to the analytical laboratory under formal chain of custody requirements as described in Section 4.7 of this QAPP. Transport sample chests will be secured with a custody seal on the outside, with signature and date provided by the attending field scientist.

4.7 Chain of Custody Considerations

All samples obtained during the course of this investigation shall be controlled as required by procedure TG-1.2-23, "Chain of Custody." Chain of custody forms (see Exhibit C in TG-1.2-23) shall be completed for each shipment of samples as described in the procedure. Chain of Custody forms shall specifically identify the applicable reference methods specified in Tables QAPP-2 and QAPP-3 as appropriate for each individual sample. Sample Integrity Data Sheets (see Exhibit B in TG-1.2-23) shall be completed for all sample collection locations, and cross reference the location and sample depth with the sample identification entered on the Chain of Custody. All laboratory chain of custody and sample tracking procedures shall ensure traceability of analytical results to the original samples through the analytical method referenced on the chain of custody, and the laboratory applied tracking number, which is traceable to unique sample identification numbers as specified in Section 4.5 above.

4.8 Sampling Equipment Decontamination

Most monitoring wells at the Monsanto project site have dedicated sampling apparatus to collect representative samples unique to the aquifer zone and depth for the well being sampled. Other locations not suited to a dedicated system will be sampled using appropriately decontaminated equipment. All non-dedicated sampling equipment (in contact with sample) shall be thoroughly cleaned prior to each sampling event to prevent cross-contamination between samples and to ensure accurate representation of analytes of interest in each sample interval. Personnel performing decontamination shall wear rubber gloves, face or eye shields, and such other safety equipment as directed by the project-specific HASP. A summary of steps used to attain proper decontamination follows:

- Samplers and sampling tools shall be disassembled as necessary and placed in clean, dedicated buckets during and after decontamination procedures to collect wash and rinse fluids.
- For samples requiring inorganic analyses, non-dedicated equipment shall be cleaned with a brush and non-phosphate detergent - water mixture such that all visible solid matter is removed.
- Steam cleaning may be conducted on drilling augers or down-hole soil sampling equipment in place of hand washing.
- A second wash is performed on non-dedicated equipment after the detergent/ water wash.
- A second and final rinse of distilled/deionized water is then applied and the sampler is ready for use.
- If the sampler will not be used immediately, it should be stored for short term in a clean plastic bag or container to protect against ambient air contaminants.

If the non-dedicated equipment retains visible matter that is not amenable to cleaning after the previously stated actions, the equipment will be retired from the sampling procedures and not used again. Samplers shall be reassembled using clean rubber gloves. All wash and rinse fluids shall be transferred to purge water collection devices, and sent for disposal to the purge water collection pond reserved for that purpose.

4.9 Calibration Requirements

Calibration of all measuring and test equipment, whether in existing inventory or purchased for this investigation, shall be controlled as required by procedure QP-11.1, "Calibration and Maintenance of Measuring and Test Equipment." Lease equipment shall require certifications or other documentation demonstrating acceptable calibration status for the entire period of use for this project. Field calibration requirements shall be in compliance with the technical procedure describing the instrument's use and/or with the manufacturer's instructions issued with the equipment. Method and analytical equipment-specific calibration requirements applicable within the individual analytical laboratories are addressed by the individual laboratory Quality Assurance (QA) plans.

5.0 ANALYTICAL PROCEDURES

Tables QAPP-2 through QAPP-8 cross-reference the analytes of interest of this investigation to the standard reference methods, practical quantitation limits (PQLs), quality control guidelines, and sample handling procedures that shall be established as contractual requirements between Golder and the subcontracted analytical laboratory. The subcontracted laboratory is responsible for implementing the analytical methods selected, documenting through Standard Operating Procedures (SOP) modifications (if any) to the methods, and providing these documents for review upon request. Any changes to the method number selected for analysis and identified in Tables QAPP-2 through QAPP-4 must first be brought to the attention of the Golder Project Manager in writing before analysis can commence.

The contractual requirements for PQLs and the most appropriate analytical methods are based upon historical records established for the site and requirements for satisfying cleanup standard guidelines as stated in National Recommended Water Quality Criteria (EPA 2011), and the Idaho primary and secondary groundwater quality standards as presented in the Idaho Department Administrative Policy Act (IDAPA) 58, Title 01, Chapter 11; Groundwater Quality Rule, (IDAPA 2011a) and surface water quality standards presented in IDAPA 58, Title 01, Chapter 02 (IDAPA 2011b). Where necessary, the laboratory will select the most appropriate method required to meet the cleanup standard.

6.0 DATA REDUCTION, VALIDATION, AND REPORTING

6.1 Minimum Requirements for Laboratory Analytical Data Packages

All analytical data packages submitted by the analytical laboratory shall include the following:

- Sample receipt "condition found" record, noting dates of sample receipt; chain-of-custody and shipping documentation including identification of field sampling personnel, and shipping personnel (or organization); copies of completed chain of custody documentation.
- Analytical hard copy (paper) summary results for each sample containing neat or dilution adjusted results for all analytes/constituents requested in the chain of custody, request for analysis or purchase order.
- Analytical quality control results and summary documents for initial and continuing calibration standards, instrument performance checks, laboratory method blanks, duplicates, laboratory control samples, blank spike/blank spike duplicates, matrix spike/matrix spike duplicates, method of standard additions, serial dilutions, surrogates and internal standards.
- Sample extraction and preparation summary data including dates of sample extraction and analysis and analytical sequence information for each sample set, and each sample dilution and reanalysis.
- Electronic data diskettes or electronic deliverables that provide the summarized results, date of extraction and analysis, quality control data results and true values, client and laboratory sample identifications, analysis methods, dilutions applied and appropriate detection or reporting limits.

All data packages for all analytical parameters shall be reviewed and approved by the analytical laboratory's QA Officer prior to submittal for validation.

6.2 General Validation Requirements

All analytical data packages from each sample delivery group shall be validated by the detailed review and calculation over-check processes described in "USEPA Contract Laboratory Program National Functional Guidelines for Superfund Inorganic Data Review" (USEPA 2010) as applicable to the analytical methods listed in Table 3 and according to the requirements of the laboratory"s Standard Operating Procedures. 100 percent of the data will be validated to Stage 2B verification and validation checks (USEPA 2009). Data validation guidance will be augmented in part by "Guidance on Environmental Data Verification and Data Validation; EPA QA/G-8" (EPA 2002b). Data validation work will be performed in order to ensure that the laboratory has met all contractual requirements, all applicable reference method requirements, and has met the data quality objectives discussed previously in Section 3.0 and Tables QAPP-2 through QAPP-8. Validated data will be stored as indicated in procedure TP-2.2-12, "Analytical Data Management" for each sample delivery group. A sample delivery group may be interpreted as a group of twenty samples, or the group of samples delivered to the laboratory in a single week, whichever occurs first.

The data validator shall document all contacts made with the laboratory to resolve questions related to the data package. The data validator shall prepare a technical report applicable for the specified method, documenting the evaluation of laboratory blanks, field blanks, equipment blanks, duplicates, matrix spikes/matrix spike duplicates, laboratory control samples, calibration data, and any re-qualification of analytical results required as a result of the validation exercise. The validation report, laboratory contact documentation, copies of the laboratory sample summary reports, and the as-reviewed laboratory data package shall be routed to the Project Manager for data assessment purposes and to the permanent project records.

7.0 QUALITY CONTROL PROCEDURES

7.1 Field Generated Quality Control Samples

All analytical samples shall be subject to quality control (QC) measures in both the field and laboratory. The following minimum field quality control requirements apply to all analyses. These requirements are adapted from "Test Methods for Evaluating Solid Waste" (SW-846) (EPA 2007).

- ***Field duplicate samples.*** An effort will be made to obtain sufficient sample quantities for the purpose of collecting field duplicates. Field duplicates will be collected of surface and groundwater samples that are suspected, based upon field observations, to contain contaminants, and where volume requirements are sufficient. Duplicate samples shall be collected from the same sampling location using the same equipment and sampling technique, and shall be placed into identically prepared and preserved containers. Therefore, duplicate samples will be generated for water collected from groundwater wells and surface water locations at the frequency noted in Tables QAPP-7 and QAPP-8 of at least one duplicate sample for every 20 samples. All field duplicates shall be identified with a unique sample ID number and will be analyzed independently (blind) as an indication of gross errors in sampling techniques.
- ***Split Laboratory samples.*** Split samples are identical samples collected at the same time in the same way, contained and transported in the same manner, but are sent to an alternate laboratory. Split samples are used as a performance audit of the primary laboratory. At a minimum, at least one split sample for every 20 samples,, or one split shall be collected per sampling event, whichever is greater. Split sampling shall be distributed evenly throughout each sampling period, with representative samples suspected to contain contaminants and where volume requirements are sufficient.
- ***Equipment blanks.*** Equipment blanks shall consist of pure deionized/ distilled commercially available water washed through decontaminated non-dedicated sampling equipment and placed in containers identical to those used for actual field samples. Equipment blanks verify the adequacy of sample containers, non-dedicated sampling equipment decontamination procedures, and the proficiency of the field technician to eliminate fugitive contaminants. Therefore, equipment blanks will be generated for water collected from groundwater wells and surface water locations at the frequency noted in Tables QAPP-7 and QAPP-8. The equipment blanks shall be collected at a location based upon the potential for the presence of field contaminants.
- ***Trip blanks.*** Trip blanks will not be required of the participating laboratory, unless and until contaminants are found in batch equipment blanks with interfering quantities of analytes that cannot be explained by sampling error, or by laboratory error. If required, they shall be created and tested by the laboratory prior to shipment, accompanied with the environmental sample set, and then returned unopened to the laboratory. The use of trip blanks will be at the Project Manager's direction, and are prepared as a check on possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions.

7.2 Laboratory Quality Control Samples

The internal quality control checks performed by the analytical laboratory shall meet the following minimum requirements:

- ***Matrix spike and matrix spike duplicate samples.*** Matrix spike and matrix spike duplicate samples require the addition of a known quantity of a representative analyte of interest to the sample as a measure of recovery percentage. The spike shall be made in

a replicate of a field sample or field duplicate sample. Replicate samples are separate aliquots removed from the same sample container in the laboratory. Spike compound selection, quantities, and concentrations shall be described in the laboratories analytical procedures as appropriate to the analytical method. One sample shall be spiked per analytical batch, or once every 20 samples, whichever is greater.

- ***Quality control reference samples (check samples).*** A quality control reference sample shall be prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. The quality control reference sample is analyzed after the initial calibration and before any samples are analyzed, and shall be run with every analytical batch, or every 20 samples, whichever is greater. Reference samples are required as an independent check on analytical technique and methodology.
- ***Method blanks.*** Method blanks are prepared during the preparation of samples in the laboratory to determine the proficiency of the laboratory at eliminating fugitive vapors, reagent contaminants, and preparation vessel carryover contaminants. The method blank shall be prepared using the same procedure used for preparation of the samples, at the same time, and involving the same reagents. The method blank must be tested after the quality control reference sample and before any samples are analyzed, and shall be run with every analytical batch or 20 samples, whichever is more frequent.

8.0 DATA ASSESSMENT PROCEDURES

As discussed in Section 6.0, analytical data shall first be compiled by the analytical laboratory, and reduced to include the specified deliverable elements. The data will be validated by project personnel in compliance with existing validation guidelines and then reported to the Project Manager and to the Client. Data assessment will be performed on the distributions and statistical characteristics of the validated data, and will consist primarily of comparisons of the data to applicable regulatory levels and historical data to assist in site characterization.

9.0 DATA MANAGEMENT

Data management involves the routing and storage of all incoming data and correspondences unique to the project activities for the purpose of security, ease of access, and compliance with project goals. The following sections describe standards in place to complete the data management process.

9.1 Records Management

All records generated for project work, will be filed and maintained in access controlled project archives as required by procedure QP-16.1 “Quality Assurance Records Management”. Records are defined as completed and signed documents that provide evidence of a service or a communication relevant to the project. Records produced during the course of the Monsanto Soda Springs project may include, but not be limited to:

- Incoming and outgoing correspondence and facsimile transmissions
- Analytical data packages and analytical quotes
- Project contracts, agreements, and amendments
- Purchase orders and subcontractor agreements, quotes and receipts
- Historical file copies of the data and communiqué provided by the Monsanto Soda Springs site and representatives
- The Work Plan, Quality Assurance Project Plan, and Health and Safety Plan
- Technical field logs and field reports
- Interim change reports, procedure alteration checklists, surveillance inspection reports, and non-conformance/ incidence reports
- Computer disk files, electronic copies of analytical data, and relevant E-mail communications

9.2 Analytical Data Management

Laboratory data will be provided to Golder in both hard copy (paper) and electronic format. The paper copy will be routed to the data validator for confirmation of analytical data receipt and subsequent validation activities. Electronic data, by diskette, or by electronic (E-mail) delivery will be reserved by the data management specialist. The electronic data will include completed report copy versions in „pdf“ or facsimile form, and in spreadsheet form amenable to inclusion by electronic import to a database. Validated analytical data packages and diskettes will be routed to the project records for controlled storage and the validated data shall be processed into the analytical database in accordance with guidance found in Technical Procedure TP-2.2-12 “Analytical Data Management”.

9.3 Data Review and Reporting

Following receipt and final data validation of groundwater analytical results, concentrations of detected analytes will be compared to established action levels. The proposed action levels for water quality at the

project site are provided in QAPP Tables QAPP-2 and QAPP-3 when compared to surface water criteria (USEPA 2011, IDAPA 2011b) or groundwater criteria (IDAPA 2011a).

Once data has been received, validated and reviewed it will be included into a summary report. The report will include the date of the sampling event, a discussion of groundwater and surface water findings, a tabular presentation of water analytical results, and comparison to established action levels for the site.

9.4 Records Turnover

Records turnovers shall be in accordance with the Quality Procedure QP-16.1 and shall be inspected prior to transmittal by the Golder Project Manager or his designee.

10.0 REFERENCES

APHA. 1998. *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, American Public Health Association,.

Golder Associates Inc. (Golder 1995). *Phase II Remedial Investigation Report for the Soda Springs Elemental Phosphorus Plant*, prepared for Monsanto Chemical Company by Golder Associates, Inc., Redmond, Washington, November 21.

Golder. 2011. *Groundwater and Surface Water Sampling Work Plan, Monsanto Soda Springs Idaho Plant,* prepared for Monsanto Chemical Company by Golder Associates, Inc., Redmond, Washington, June.

IDAPA. 2011a. Idaho Administrative Policy Act, *Water Quality Standards*, IDAPA 58, Title 01, Chapter 02, 2011.

IDAPA. 2011b. Idaho Administrative Policy Act, *Ground Water Quality Rule,* IDAPA 58, Title 01, Chapter 11, 2011.

United States Environmental Protection Agency (USEPA). 1983. *Methods for Chemical Analysis of Water and Wastes* (EPA-600/ 4-79-02), March.

USEPA. 2002a. *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5,* (EPA/240/R-02/009), December.

USEPA. 2002b. Guidance on Environmental Data Verification and *Data Validation; EPA QA/G-8,* EPA/240/R-02/004, November.

USEPA. 2007. *Test Methods for Evaluating Solid Waste, Revision 6, (SW-846), February*.

USEPA. 2009. Guidance for Labeling Externally Validated Laboratory Data for Superfund Use, EPA-540-R-08-005, January.

USEPA. 2010. USEPA Contract Laboratory Program, *National Functional Guidelines for Superfund Inorganic Data Review,* Final, EPA-540/R-10-011, January.

USEPA. 2011. National Recommended Water Quality Criteria, http://water.epa.gov/scitech/swguidance/standards/current/index.cfm (accessed April 19, 2011).

TABLES

Table QAPP 1: Golder Technical Procedures and Quality Procedure Documents

TG-1.2-20	Collection of Groundwater Quality Samples
TG-1.2-23	Chain of Custody
TP-1.2-26	Surface Water Sampling Methods
TP-1.2-27	Measurement of Stream Discharge Using a Current Meter
TG-1.4-6a	Manual Groundwater Level Measurement
TP-2.2-12	Analytical Data Management
QP-5.1	Document Preparation, Distribution, and Change Control
QP-10.1	Surveillance Inspection
QP-11.1	Calibration and Maintenance of Measuring and Test Equipment
QP-14.1	Corrective and Preventive Action
QP-16.1	Quality Assurance Records Management

Table QAPP-2: Sample Collection / Metal Analytes

		Idaho Groundwater Quality Standards[a]	National Surface Water Quality Criteria[b]	Idaho Surface Water Criteria[c]	Method Reference and Reporting Limits (RL)				Method Quality Control	
Parameter	CAS Number	Units (µg/L)	Units (µg/L)	Units (µg/L)	ICP-AES[d]	RL Units (µg/L)	ICP-MS[e]	RL Units (µg/L)	Precision RPD	Accuracy % Recov.
Cadmium	7440-43-9	5	0.25	0.6	6010C	5	6020A	1	<20%	75-125%
Calcium	7440-70-2	NA	NA	NA	6010C	5000		--	<20%	75-125%
Magnesium	7439-95-4	NA	NA	NA	6010C	5000		--	<20%	75-125%
Manganese	7439-96-5	50[II]	NA	NA	6010C	10	6020A	1	<20%	75-125%
Molybdenum	7439-98-7	NA	NA	NA	6010C	8		--	<20%	75-125%
Potassium	7440-09-7	NA	NA	NA	6010C	5000		--	<20%	75-125%
Selenium	7782-49-2	50	5	5	6010C / SM 3114C	200	6020A	3	<20%	75-125%
Sodium	7440-23-5	NA	NA	NA	6010C	5000		--	<20%	75-125%
Vanadium	7440-62-2	NA	NA	NA	6010C	30	6020A	1	<20%	75-125%
Zinc	7440-66-6	5000[II]	120	120	6010C	60	6020A	2	<20%	75-125%

Notes:

NA Not available for this analyte.

a - Idaho Primary Constituent Groundwater Quality Standards unless indicated as Secondary Constituent Groundwater Quality Standard (Superscript „II" designation identifies an Idaho Secondary Constituent Groundwater Quality Standard per IDAPA 58.01.11, 2011).

b - National Recommended Water Quality Criteria: 2011; Values are for freshwater chronic criteria concentrations using a hardness coefficient of 100 mg/L where applicable (Shaded value is currently below Method Reporting Limits for the method cited).

c.- IDAPA 58 Title 01, Chapter 02 Water Quality Standards, chronic criteria

d - ICP-AES; Ion coupled plasma and atomic emission spectroscopy (except Se). Reference from „Methods for Chemical Analysis of Water and Wastes" (EPA-600/ 4-79-02).

e - ICP-MS; Ion coupled plasma and mass spectrometry.

Table QAPP-3: Sample Collection / General Chemistry Analytes

Parameter	Idaho Groundwater Quality Standards[a]	National Surface Water Quality Criteria[b]	Idaho Surface Water Quality Criteria[c]	Method Reference[d]	Detection Reporting Limit	Precision RPD[e]	Accuracy % Recovery
Total Alkalinity (as $CaCO_3$)	NA	20 mg/L	- -	SM 2320B	1 mg/l	<20%	75-125%
Ammonia/ Ammonium (as N)	NA	pH, Temp. dependent	pH, Temp. dependent	EPA 350.1	0.01 mg/l	<20%	75-125%
Chloride	250 mg/L[II]	230 mg/L	- -	EPA 300.0	1 mg/l	<20%	75-125%
Fluoride	4 mg/L	- -	- -	EPA 300.0	1 mg/l	<20%	75-125%
Nitrate/Nitrite (as N)	10 mg/L	- -	- -	EPA 353.2	0.05 mg/l	<20%	75-125%
Total Phosphorus (as P)	NA	- -	- -	EPA 365.2	0.01 mg/l	<20%	75-125%
Sulfate	250 mg/L[II]	- -	- -	EPA 300.0	1 mg/l	<20%	75-125%
TDS	500 mg/L[II]	- -	- -	SM 2540 C	10 mg/l	<20%	NA

Notes:

a – Idaho Primary Constituent Groundwater Quality Standards unless indicated as Secondary Constituent Groundwater Quality Standard by superscript II.

b - National Recommended Water Quality Criteria: 2002; Values are for freshwater chronic criteria concentrations using a hardness coefficient of 100 mg/L where applicable.

c - IDAPA 58 Title 01, Chapter 02, Water Quality Standards, chronic criteria.

d – Methods for Chemical Analysis of Water and Wastes, (EPA 1983); Standard Methods for Examination of Water and Wastewater, (APHA 1998).

e – Relative Percent Difference.

Table QAPP-4: Groundwater Field Parameter Monitoring List

Field Tests	Method[a]	Target Water PQL[b]	Typical Instrument Applied[c]
Temperature	SM2550	0.1 deg. C	Golder Calibrated Mercury Thermometer
pH	EPA 150.1	0.05 units	Orion 3 Star with pH Electrode or Model 250Aplus with Combination Glass Electrode.
Specific Conductance	EPA 120.1	5 umhos/cm	Orion 3 Star with Conductivity Electrode Cell or Model 115Aplus with Epoxy 2 Electrode Conductivity Cell.
Turbidity	EPA 180.1	1 NTU	Hach 2100P with dual optical compensation.
Dissolved Oxygen	SM4500-O	0.1 mg/L	Orion 3 Star with Dissolved Oxygen Electrode or Model 810Aplus with Combination Glass Electrode.

Notes:

a - Methods cited are from „Methods for the Chemical Analysis of Water and Wastes" (EPA-600/4-79-20; EPA 1983); and „Standard Methods for the Examination of Water & Wastewater" (APHA 1998, 20th Ed.).

b - PQL: Practical Quantitation Limits established by Manufacturers recommendation.

c - Orion and Hach are registered trademarks. Refer to instrument operator manuals for calibration and troubleshooting.

Table QAPP-5: Sample Container Types, Volumes, Handling, Preservation, and Holding Times

Analytes	Analytical Method	Container Type	Special Handling	Preservation	Maximum Holding Time
pH, Temperature, Conductivity, Dissolved Oxygen, Turbidity	See Table QAPP-3	Field Parameters; Sample is not collected	See Table QAPP-6	Field Parameters; Sample is not collected	Field Parameters; Sample is not collected
Dissolved Metals, Selenium	EPA 6010B / 6020 SM 3114C	1, 1000 mL polyethylene bottle.	Use 0.45 um filter only for samples with turbidity >5 NTU (Bailer collected samples only). Collect into preserved bottle, fill to neck	HNO_3, pH < 2, store at 4°C.	6 months 6 months
Total Metals, Selenium	EPA 6010B/ 6020 SM 3114C	1, 1000 mL polyethylene bottle.	Fill to neck	HNO_3, pH < 2, store at 4°C	6 months 6 months
Total Alkalinity	EPA 310.1	1, 1000 mL narrow mouth polyethylene bottle.	Fill to neck, do not uncap until ready for analysis	None, store at 4°C	14 days
Total Phosphorus, Ammonia and Ammonium, Nitrate+Nitrite-N	EPA 365.2 EPA 350.1 EPA 353.2	1, 1000 mL narrow mouth polyethylene bottle.	Fill to neck	H_2SO_4, pH <2, store at 4°C.	28 days
Chloride, Fluoride, Sulfate	EPA 300.0	1, 1000 mL polyethylene bottle.	Fill to neck	None, store at 4°C	28 days
Total Dissolved Solids	EPA 160.1	1, 1000 mL polyethylene bottle.	Fill to neck	None, store at 4°C	7 days

Table QAPP-6: Quality Control Summary; Metal Analyses

Parameter	Description
Method Reference	Methods for Chemical Analysis of Water and Wastes, (EPA 1983); Test Methods for Evaluating Solid Waste; SW-846, (EPA 2007) Standard Methods for Examination of Water and Wastewater, (APHA 1998)
Matrix	Surface water, Groundwater.
Analytes	Metals lists as indicated in Table QAPP-2.
Holding Time	6 Months.
Laboratory Instrument Calibration	ICP: A blank and at least one calibration standard. The low level standards must be analyzed at the method specified concentration at the required frequency.
Laboratory Method Blank	Blank sample is analyzed at each analyte parameter and no analytes should be found in the blank. At least one preparation blank must be prepared for each matrix per 20 field samples or each batch whichever is more frequent. If any analyte concentration in the preparation blank is above the reporting limit, the lowest concentration of that analyte in the associated sample must be 10 times the concentration in the blank.
Laboratory Calibration	Laboratory calibration blanks analyzed at beginning and end of analytical batch and after initial and continuing calibration or every 10 samples or two hours, whichever is more frequent.
Equipment Blanks	GROUNDWATER: Equipment blanks will be collected at a minimum frequency of one per each set of twenty samples collected, for each type of collection device used. SURFACE WATER: Equipment blanks will be collected at a minimum frequency of one per each set of twenty samples collected.
Laboratory QC Check Standards	ICP initial calibration verified with independent standard %R 90-110. Digest an independent LCS with each sample batch for ICP if available %R 80-120.
Duplicate Sample	GROUNDWATER: Field duplicates are scheduled to be collected at a minimum frequency of one per each set of twenty samples collected. Each is prepared as a blind field duplicate. Relative percent differences (RPD) between field duplicates are advisory only; ≤20% for water samples. (MS/MSD or BS/BSD checked for RPD also). SURFACE WATER: Field duplicates will be collected at a minimum frequency of one per each set of twenty samples collected. Additional criteria as above.
Laboratory Matrix Spike/ Matrix Spike Duplicate Sample	Analyze spiked field sample at frequency of one per twenty samples or each batch, whichever is more frequent for groundwater and surface water samples. Percent recovery (%R) between 80-120%. Use method of standard additions for Se by hydride generation if interference is indicated.
Sample Collection	WATER: 1,000 ml polyethylene bottle acidified with HN03 to pH <2 and cool to 4°C.
Other Laboratory QC Criteria	ICP: Analyze ICS at beginning and at end of run or twice during 8 hour shift, whichever is more frequent. Results ±20% of true value. To verify linearity near the detection limit, analyze standard at 2X the limit and analyze at the beginning and end of the run or twice per 8 hours. Serial dilution analysis performed if concentration is 50X limit, must agree ±10% of the original value. All measurements minimum of 2 replicate exposures, report average. Se by hydride generation: Serial dilution analysis performed if concentration is 25X limit, must agree ±10% of the original value. Method of standard additions required if interference is indicated.

Table QAPP-7: Quality Control Summary; General Chemistry Analyses

Parameter	Metals
Method Reference	Chemical Methods for the Analysis of Water and Waste. Standard Methods for the Examination of Water and Wastes.
Matrix	Groundwater, Surface water.
Analytes	Total Alkalinity (as $CaCO_3$), Ammonia and Ammonium (as N), Chloride, Fluoride, Sulfate, Nitrate+nitrite-N, Total Phosphorus (as P), TDS.
Holding Time	28 days for chloride, fluoride, sulfate, unpreserved. 28 days for ammonia, nitrate/nitrite, phosphorus if preserved. 14 days for alkalinity unpreserved, and 7 days for TDS, unpreserved.
Calibration	A blank and at least three calibration standards for spectrophotometer, and anion analysis. One standard must be analyzed at or near the method reporting limit. Verify calibration prior to sample analysis, every twenty samples and at the conclusion of sample analysis. Balance check with NIST traceable standard weight for TDS analysis.
Method Blank	Blank sample is analyzed at each analyte parameter and no analytes should be found in the blank. At least one preparation blank must be prepared for each matrix per 20 field samples or each batch whichever is more frequent. If any analyte concentration in the preparation blank is above the reporting limit, the lowest concentration of that analyte in the associated sample must be 10 times the concentration in the blank.
Other Blanks	Analyze calibration blank at beginning and end of analytical batch and after initial and continuing calibration or every 10 samples or two hours, whichever is more frequent. Evaluate other associated blanks such as equipment blanks and field blanks at the same frequency of method blank analyses above.
QC Check Standards	Initial calibration verified with independent standard %R 90-110, with the exception of TDS. Digest an independent LCS with each sample batch for each matrix if available, acceptable %Recovery 80-120.
Duplicate Sample	Analyze one duplicate per 20 field samples or each batch for each matrix. Relative percent difference (RPD) ≤20% for water samples ≤35% for soil samples. Blind field duplicate sample recommended.
Spike Sample	Analyze spike field sample at frequency of one per twenty samples or each batch, whichever is more frequent for each matrix. Percent recovery (%R) between 80-120%.
Sample Collection	Water for Nitrite/Nitrate, Ammonia, & Phosphorus analysis; 1000 ml, preserve with H2SO4 to pH < 2, refrigerate at 4°C. Water for Chloride, Fluoride, Sulfate, Alkalinity analysis; 1000 ml polyethylene bottle unpreserved, refrigerate at 4°C.
Other QC Criteria	To verify anion linearity near the detection limit, analyze standard at 2X the limit and analyze at the beginning and end of the run or twice per 8 hours. Verify linear ranges quarterly. Results must be within ±5% of true value.

Table QAPP-8: Quality Control Summary; Field Parameters

Parameter	Description
Method References	GAI Technical Procedures TG-1.2-20, Collection of Groundwater Quality Samples; TP-1.2-26 Surface Water Sampling Methods. Orion and Hach Technical Operator Manuals
Matrix	Surface Water (Streams) and Groundwater (well sampling).
Analytes	pH, specific conductivity, dissolved oxygen, turbidity, and temperature.
Maximum Holding Time	Record all field parameters immediately upon collection or during steady state conditions.
Calibration	At least two reference buffers or standards at a high and low concentration are used to calibrate pH, conductivity. A blank and at least one calibration standard shall be used for turbidity, and dissolved oxygen slope determined by saturated atmosphere. Verify calibration prior to sample analysis and at the conclusion of sample analysis. NIST traceable thermometer shall be used for temperature measurements, no field calibration is required.
Method Blank	A method blank or rinse blank sample is analyzed when required to check calibration.
Equipment Blanks	Equipment blanks will include monitoring of distilled or deionized water used in equipment preparation as appropriate.
QC Check Standards	Reanalysis of standards following field sample analyses is required. Verification of standards values should be ±10%.
Surrogate	NA
Internal Standard	NA
Duplicate Sample	Duplicate sample analyses are not required, however, repeat analysis of a second sample aliquot is recommended for all parameters and required for groundwater sampling to verify stability of field measurements within 10% for all parameters (0.5 °C for temperature).
Spike Sample	Spike sample analyses are not required.
Sample Collection	Minimize both atmospheric contact and delay on analyses of all field parameters. A closed cell sampling configuration may be used.
Other QC Criteria	The working calibration must be verified before and after field sampling analyses. If the response for any analyte varies from the expected value by more than ±10% (0.5 °C for temperature), the test must be repeated using fresh calibration standards.

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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